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BULLETIN OF HYDROLOGICAL AND METEOROLOGICAL SERVICE (SELECTED A--ETC(U)
APR 82 K LECHOWICZ-KWIECIEN, M ZMIJEWSKI

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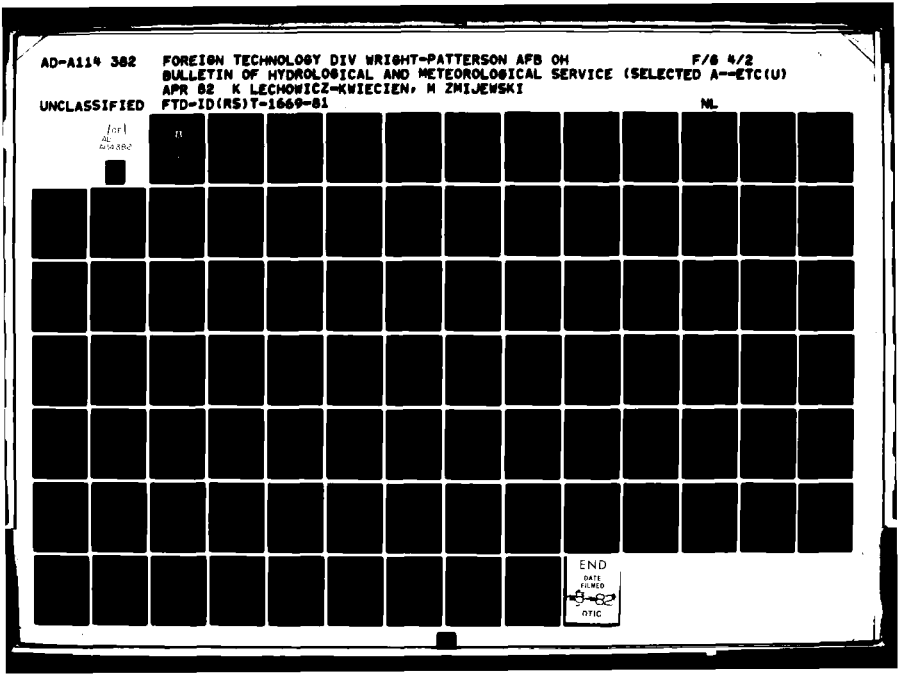

FTD-ID(RS)T-1669-81

FOREIGN TECHNOLOGY DIVISION

BULLETIN OF HYDROLOGICAL AND METEOROLOGICAL SERVICE

(Selected Articles)

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EDITED TRANSLATION

FTD-ID(RS)T-1669-81 2 April 1982

MICROFICHE NR: FTD-82-C-000434

BULLETIN OF HYDROLOGICAL AND METEOROLOGICAL SERVICE
(Selected Articles)

English pages: 81

Source: Wiadomości Sluzby Hydrologicznej i Meteorologicznej, Bulletin du Service Hydrologique et Meteorologique, Vol. 6, Nr. 4, 1958, pp. 149-201

Country of origin: Poland
Translated by: LEO KANNER ASSOCIATES
F33657-81-D-0264
Requester: USAF/ETAC/MAC

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

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ABSTRACT

Presented in this work are the characteristics of the following meteorological elements: temperature, wind, pressure, air, precipitation, humidity, cloud cover, and storms. The material is constituted of meteorological observations at stations in Hel, Chałupy, Gdynia, Rozewie, and Karwia during the period 1928-1938.

The main special feature of this region is the great variability in each of the elements cited here, both from day to day as well as from year to year.

The longest season of the year is the transitional period between the short summer and the winter, that is, the periods of before spring, the spring itself, the autumn, and before winter. The summer is relatively cold, and the winter is primarily mild. The early autumn is the nicest season of the year, but towards the end of autumn, a cycle of strong storms begins which lasts up until spring.

INTRODUCTION /3

It is difficult to address the climate of the Hel Peninsula as a discrete climatic unity. The too small area and the relatively short observational period (11 years) makes it necessary to take this problem as a contribution to the Peninsula climate as an intimate component of the neighboring shore region.

The topographical disposition of the Peninsula itself, jutting out into the sea for 35 km [15], influences the free flow of air masses out of the northerly, easterly, and southerly directions. The land surrounding Pucka Bay from the west, formed in the shape of morraines from the last glaciation, constitutes a firm barrier against the transport of westerly air masses. The Baltic Sea waters flow around the scythe-shaped Hel Peninsula out of the northeast, stamping their impression directly on the climate of the Peninsula; this may be seen clearly particularly when we take into consideration the relatively small width of the Peninsula, that is, 200 m at its base and up to 3 km at the promontory. The influence of the shallow Pucka Bay is minimal.

The vertical configuration of the Peninsula favors the free interchange and movement of air masses. The whole area possesses the character of sand dunes, with a maximum elevation of 23.2 m above sea level, with the dunes along the open sea shore somewhat higher than the dunes along the Bay side. The sparse forest growing over the Peninsula terrain has only a small effect on climatic phenomena.

The Hel Peninsula, according to climateclassifications worked out up to the present, belongs in the "Cfb" zone ("beech climate"), for example, of W. Köppen [12]; it belongs to the 7 (text obscure) according to Władsław Gorczyński [4]; and it lies within the area of the "Baltic climate" of E. Romer [18]. Stanslaw Kończak [10], in his sketch of the hydrography and climatology of the Baltic area with respect to the Polish coastline, refers only to Hel and bases upon it the climatic characteristics of this part of the Baltic. Z. Kaczorowska [9] discusses the climatic conditions of the Polish Baltic coastline during the interwar period, basing her views on observational material taken from Hel, Gdynia, Pucka, and Karwia. Indeed, with the exception of Z. Kazcorowska's work, there is no thorough treatment in the Polish literature on the climatic relationships of this part of the coastline.

In developing the individual meteorological elements here, Hel is taken account of throughout. The works touching on this subject are named in the bibliography.

ON THE CLIMATE OF THE HEL PENINSULA

Kristina Lechowicz-Kwiecien

MATERIALS AND METHODS

The few meteorological stations in the northern part of Poland, such as the Hel station, have been carrying out observations for a long time. The length of observations carried out in Hel dates from the year 1851; this was broken only during the period of the First and Second World Wars. The observational material from the Hel station are located in Deutsches Meteorologisches Jahrbuch Preussen und Übrige norddeutsche Staaten [The German Meteorological Yearbook for Prussia and the Other North German States], and beginning with the year 1926, in the Polish work, Roczniki Meteorologiczne [Meteorological Yearbooks].

The material for the present study are the results of meteorological observations taken in the following stations: Series II -- in Hel, and Series III -- in Jastarnia and Chałupy. For comparison, observations have been taken from the nearest stations, that is, Gdynia, Pucka, Rozewie, and Karvia. This treatment /4 covers the 11-year period from 1928 to 1938. Almost all the meteorological elements are based on complete material, with the exception of the extreme temperatures, which were developed on the basis of a 12-year period, and the pressure is taken for only 8 years. In addition to these basic shortcomings, smaller gaps occur throughout the material that have been filled in by means of interpolation from comparisons with neighboring stations.

At Jastarnia for 31 August 1928, there is a break in the temperature and wind observations. For 1929 in May, July, and December, the precipitation is not noted for the 31st. In September 1931, there is no precipitation noted for the first 10 days. These breaks have been filled in by means of comparisons with the Hel and Chałupy locales. The rain gauge in Jastarnia had been set up in an unsuitable location (it was surrounded by trees and farm buildings). For this reason, the values for precipitation, as well as the values for wind velocity and wind direction, for the same reasons, should be taken with some reservation at this station. There is a break in the results of meteorological observations from December 1937 at the Pucka station. The mean monthly values have been filled in on the basis of comparison with data from Rozewie and Gdynia. Rozewie has been left out in elaborations on the precipitation, because there are large breaks in the precipitations noted.

In the treatment of individual meteorological elements, auxiliary statistical means have been used.

ANALYSIS OF CLIMATE ELEMENTS

Concerning the type of weather, as well as the type of climate, it is the set of meteorological elements that is decisive; these elements include the temperature, wind velocity and wind direction, precipitation, humidity, and other elements forming a system with a dynamics that is unique with respect to itself. In this kind of set, each element plays an important role, but at the same time, it is dependent to a large degree on the course and behavior of the other elements. We shall go now to an analysis of the individual meteorological elements.

I. Temperature

We shall begin the treatment of wind temperature recorded on the Hel Peninsula with an analysis of the annual course based on the mean monthly values (Table 1 and Fig. 1). The identical mean annual temperature of 7.8°C for all points on the Peninsula (Hel, Jastarnia, Chałupy) distinguishes it from the background. Whereas Rozewie, Pucka, and Karwia show lower values, Gdynia differs from Hel by hardly 0.1°C toward the minus. The differences between individual stations only reach decimal portions of a degree, and the greatest difference amounts to only 0.5°. The entire sector of the Polish coast under study here is contained between the isovents of 7° and 8°C.

Table 1. Monthly and annual mean temperatures (1928-1938)

Locale	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	—0.6	—1.0	1.3	4.8	10.3	14.1	17.2	17.2	14.1	9.8	5.4	1.0	7.8
Jastarnia	—0.7	—0.9	1.5	4.9	9.9	14.0	17.1	17.4	14.3	9.8	5.3	1.2	7.8
Chałupy	—0.8	—0.9	1.5	5.0	10.0	14.4	17.6	17.5	14.3	9.6	5.1	0.9	7.8
Gdynia	—0.9	—1.0	1.8	5.3	11.2	14.8	17.5	17.2	13.7	9.3	4.8	0.5	7.7
Puck	—1.0	—1.2	1.3	4.9	10.4	14.1	16.8	16.4	13.1	8.9	4.5	0.4	7.4
Rozewie	—1.0	—1.0	1.3	4.5	9.4	13.4	16.5	16.6	13.4	9.0	4.7	0.6	7.3
Karwia	—0.7	—0.8	1.5	5.0	9.9	14.0	17.0	16.9	13.7	9.2	4.8	0.7	7.8

Curves of the mean monthly temperatures over the course of a year have a similar character. The very small interval in values for the individual months is given over the course of a year by only a single line, rising to its highest in July and August, with a minimum in February. The mean values for July and August vary around /5

Table 2. Mean highest (a) and lowest (b) monthly and annual temperatures (1928-1938)

Locale		Month												Year
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	a	2,1	2,2	5 2	6 9	13 0	15 8	19 2	19 2	16 3	11,4	7,6	3,6	9.2
	b	−3.5	−9,2	−1,3	1,2	7,8	11,7	15,8	15,5	11,3	7,1	3,1	−1,8	6.3
Jastarnia	a	1,9	2,2	5,6	7,1	12,4	15,9	18,9	19,5	16,3	11,4	7,3	3,3	9.2
	b	−3,4	−8,8	−1,6	1,6	7,6	11,8	15,4	15,5	11,5	7,3	3,3	−1,6	6.3
Chalupy	a	1,7	2,2	5,7	7,2	12,2	16,2	19,2	19,6	16,4	11,1	7,2	3,2	9.2
	b	−4 0	−8,9	1,6	2,1	7,9	12,0	16,6	15,7	11,6	7 1	3 3	−1 7	6.3
Gdynia	a	2,0	2,4	6,7	7,8	14,2	16,8	19,4	19,6	15,8	10,8	7,1	3,0	9.2
	b	−4,7	−10 2	−1 6	1 4	8 6	12 4	16 3	15 2	11,3	7,0	2,6	−2,3	6.2
Puck	a	1,8	2,0	5,7	7,2	13,2	16,0	18,6	19 0	14,8	10,4	6,9	3,0	8.7
	b	−4,4	−9,9	−2,3	1,1	7,9	11,7	15,3	14,7	10,9	6,8	2,4	−2,2	5.8
Rozewie	a	1,7	1,9	5,3	6,8	12,0	15,7	18,3	18,4	15,5	10,6	6,8	3,0	8.7
	b	−4,1	−8,5	−1,7	1,3	7,0	10,8	15,4	14,8	11,0	6,4	2,6	−2,0	5.8
Karwia	a	2 0	2,3	5,4	7,2	12,4	16,1	18,8	18,3	15 3	10 8	7 0	3 2	9.0
	b	1 3	−8,6	1,5	1,1	7,2	11,5	15,0	14 1	11,3	7,0	2,9	−2,9	6.0

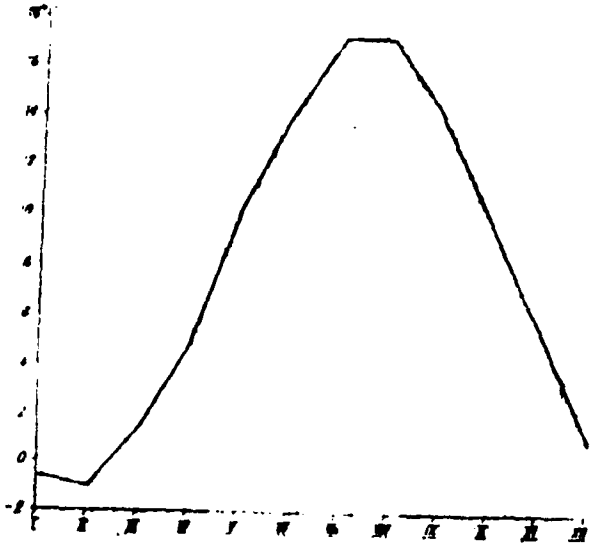

Fig. 1. Annual course of mean monthly temperatures at the Hel station (1928-1938).

17°C, with the exception of Rozewie and Pucka, which show lower values. The minimum in February varies across the interval from -0.8 (Karwia) to -1.2 (Puck). The differences between individual locales are insignificant.

The means for the individual stations over the course of 11 years show no special variations.

From a compilation of mean extreme values for a given month (Table 2), which gives in a general outline a view of the variability of this element from year to year, we may see that it is only February that is distinguished by a greater interval of values; for Hel, this interval is 11.4° and for Gdynia 12.4°. It is necessary to note that the February minimum falls in the year 1929, but this is characteristic as regards the exceptionally bitter course of the winter for all of Poland for that year. In addition, the greatest mean annual temperature was recorded in 1934 at all the stations.

Table 3 illustrates the annual temperature amplitudes. The numbers contained in it stress the prominent influence of the sea on the regulation and control of the thermal relationships; for all the stations, the annual amplitudes are only around 18°C.

Table 3. Annual high temperature (1928-1938)

Locale	High temperature for the year
Hel	18.2
Jastarnia	18.3
Chalupy	18.5
Gdynia	18.5
Puck	18.0
Rozewie	17.6
Karwia	17.8

The absolute temperature minima and maxima are shown in Table 4. The highest temperature at Hel reaches 31.7°, which accompanies the passage of continental masses and among the mean annual or monthly air temperatures, is not significant. The relatively high minimums (-17.1° at Hel, -18.3° at Gdynia, -20.4° at Karwia) are characteristic for coastal areas. It is necessary to note, however, that in Table 4, it

Table 4. Absolute temperature maxima (a) and minima (b) 91930-1938)

Locale		Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hel	a	8.3	7,8	20 6	17,5	27,7	31.7	30 6	31,5	26,9	21,4	12,5	9,0
	b	−15.0	− 17,1	−12.3	− 7 8	—4,9	−0,3	6,6	5.3	−0.9	−2.2	− 7,2	−14,3
Gdynia	a	13 5	12.4	21.2	24.0	31 2	33,0	33.1	34 1	29 2	23.6	15.8	11.6
	b	−13.3	15 8	13.0	− 6.3	−2,4	1 0	6,8	7.2	1.5	− 2 1	10.3	−15,6
Karwia	a	12.0	12,0	20.8	23.8	32,2	34,7	31,6	33.8	32.0	24,7	18 1	16.8
	b	20 4	16.7	13.3	0 1	−4,5	− 0 5	4.6	6,1	−0,5	−2,2	−11,7	−16 3

is the time interval from 1930 to 1938 that was under consideration, and the low temperatures of the bitter winter of 1928/1929 were not considered.

The number of days with minimum teperatures for a 24-hour period lower than 0° is on the average for Hel 95.8, 105.3 for Karwia, and 91.4 for Gdynia. Their distribution over the period of a year is shown in Table 5. In Hel and Karwia, it is only July and August that are free of frost.* In addition, Gdynia recorded no /6 temperature below 0° in June and September.

Table 5. The average number of days with minimum temperatures for a 24-hour period lower than 0°C (1929-1938)

Locale	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	21,1	20.9	19.6	10,1	1,8	0,1	.	.	0.1	0.5	5.4	16,2	95.8
Gdynia	21,4	20,5	17.2	7 4	0 6	.	.	.	.	0,4	5,8	18,1	91.4
Karwia	23.2	21 7	20.6	9.9	1,4	0,1	.	.	0,1	0 8	8 2	19,3	105.3

The dates for the last and first frosts are contained in Table 6. The average number of days without frost is at 177 for Hel, 176 for Karwia, and 214 for Gdynia.

The durations for the individual seasons of the year (Table 7) are noted taking for the pre-spring and pre-winter the average daily temperatures to be between 0° and 5°, from 5° to 15° for spring and autumn, higher than 15° for the summer, and lower than 0°C for the winter. Taking the number of days for pre-spring and spring or for pre-winter and autumn together, it can be seen that the shortest season of the year at Hel is summer, and then winter. The transitional periods

*The months that are free of frost are noted in Table 5 with dots.

between these seasons are long (101 and 104 days). The vegetation period for Hel is 208 days, with an average date for the beginning of 23 April and for the end 16 November. The farming season is considerably longer (281 days), lasting from 13 March to 19 December.

Table 6. Dates of the last (a) and first (b) frosts (1929-1938)

Locale		Average date of appearance of frost	Dates for the appearance of frost	
			Earliest	Latest
Hel	a	8 May	13 April 1934	2 June 1932
	b	2 November	29 September 1931	20 December 1929
Gdynia	a	19 April	31 March 1937	9 May 1935
	b	20 November	27 October 1931	14 December 1938
Karwia	a	1 May	1 April 1937	1 June 1930
	b	25 October	29 September 1931	19 November 1935

Table 7. Duration of individual seasons of the year at Hel station

Season of the year	Average date		Number of days
	Beginning	End	
Pre-spring	13 March	22 April	41
Spring	23 April	21 June	60
Summer	22 June	6 September	77
Autumn	7 September	16 November	71
Pre-winter	17 October	19 December	33
Winter	20 December	12 March	84

The temperature variability from month to month (Table 8) is characterized by a large jump from April to May (from 4.9 to 6.0). A relatively large divergence (lower than 4.0) was recorded in the period from September to December. The smallest differences occur between January and February, as well as between July and August.

The temperature on the Hel Peninsula is characterized, at the same time, by great variability from day to day (Table 9). The most frequent changes towards the minus take place in the month of January, but the greatest sum of the values of

Table 8. Temperature variability from month to month on the basis of average monthly temperatures (1928-1938)

Locale	Month										
	I/II	II/III	III IV	IV/V	V/VI	VI.VII	VII.VIII	VIII.IX	IX X	X/XI	XI/XII	XII/I
Hel	−0,4	+2,4	+3,4	+5,5	3,8	3,1	0,0	−3,4	−4,3	−4,4	−4,4	−1,8
Jastarnia	0,0	−2,4	+3,4	+5,0	+4,1	3,1	+0,3	−3,1	−4,5	−4,9	−4,1	−2,1
Chalupy	−0,1	+2,4	+3,5	+5,0	+4,4	3,[illegible]	−0,1	−3,2	−4,7	−4,5	−4,2	−1,7
Gdynia	−0,1	+2,8	+3,5	+6,0	+3,5	2,8	−0,4	−3,5	−4,4	−4,5	−4,3	−1,4
Puck	−0,2	+2,5	+3,6	+5,5	+3,7	2,7	−0,4	−3,3	−4,2	−4,4	−4,1	−1,4
Rozewie	0,0	+2,3	+3,2	+4,9	+4,0	3,1	+0,1	−3,2	−4,4	−4,3	−4,1	−1,8
Karwia	−0,1	+2,3	+3,5	+4,9	+4,1	3,0	−0,1	−3,2	−4,5	−4,4	−4,1	−1,1

Table 9. Temperature variability from day to day in individual months at the Hel station according to the average daily temperatures for the period 1928-1938

Number of changes	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Number of changes in minus	19	16	11	12	11	10	11	17	17	18	17	18
Number of changes in plus	11	13	18	18	18	18	17	12	11	13	10	12
Sum of value of changes/minus	−6,4	−5,8	−5,8	−4,4	−4,6	−6,1	−5,1	−5,5	−9,1	−8,9	−9,8	−7,6
Sum of value of changes/plus	4,7	7,1	9,3	8,2	10,3	10,2	6,5	4,5	5,4	3,8	4,0	4,9

these kinds of changes falls in November (-9.6). In general, the months from August to December, as well as from January and February, show greater than 50% of days with changes towards the minus, whereas in the other months this variability is present for only 10% of the days. The greatest occurrence of heat waves takes place in May and June with an equally frequent number of the greatest sums for changes towards the plus. March should be placed in third position, which despite the fact that it has the same number of changes towards the plus as May and June, still the sum of the value of these changes is lower (9.3).

The temperature variability from day to day is great; this may be seen vividly on a graph of the yearly course of the 24-hour temperatures (Table 10 and Fig. 2). High mean monthly temperatures for the winter period (December, January, February) are characteristic for coastal regions, and this is reflected in agreement in the high daily mean temperatures, which oscillate around a value not much lower than /7 0°C.

We shall go now to a description of the curve of mean daily temperatures for the period 1928-1938 shown in Fig. 2.

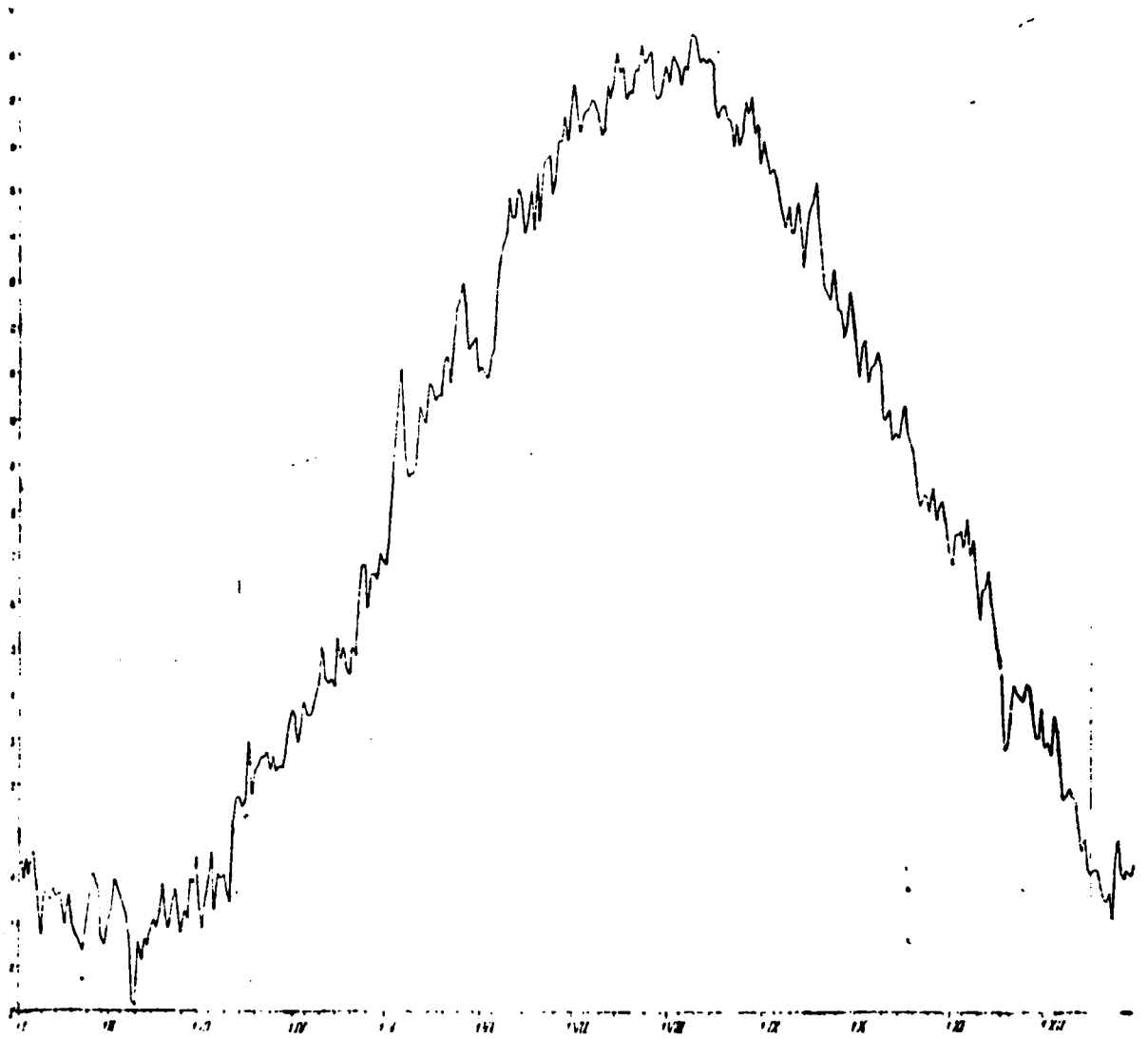

Fig. 2. Yearly course of 24-hour temperatures at Hel station according to the mean normal temperatures (for the period 1928-1938).

The annual course of temperatures for the Hel station shows its greatest and least variation during the winter period. The lowest temperatures recorded are towards the end of the first 10-day period in February. From the midpoint in March, the curve begins to rise, showing only relatively small fluctuations during the encroachments of colder waves of air. A great temperature increase follows in the first days of May. During this period, the curve increases to higher values than the mean annual temperature, which for the Hel station is 7.8°C. The marked bends in the curve for May indicate the frequent returns of cold air masses. The greater invasion of warm masses is noted towards the end of the first 10-day period in June, after which there follows a short-wave fluctuation in the curve with an amplitude on the order of 1°C. In the first half of July, the temperature

Table 10. Mean daily temperature for Hel station (1928-1938)

Day	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	0,2	—1,0	0,4	[illegible]	6,9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,7
2	0,3	-0,8	-0,7	[illegible]	6,8	11,1	[illegible]	[illegible]	[illegible]	11,0	[illegible]	2,3
3	-0,1	0,1	- 1,2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	—0,4	—3,3	—0,5	[illegible]	8,4	[illegible]	[illegible]	[illegible]	[illegible]	11,0	[illegible]	[illegible]
5	0,0	-0,5	—0,1	[illegible]	9,3	[illegible]	[illegible]	[illegible]	[illegible]	11,7	[illegible]	[illegible]
6	0,3	-0,7	0,5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	0,5	—0,9	—0,8	[illegible]	11,1	12,6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	0,2	—1,1	0,0	[illegible]	9,4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	—0,9	—2,8	—0,1	[illegible]	8,7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	—1,3	—2,9	0,0	[illegible]	8,8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	—1,5	—0,4	[illegible]	8,8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	—1,9	—0,6	[illegible]	9,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	0,6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	—0,5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	—0,4	—1,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	—0,7	—1,2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	—1,1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	—0,4	—0,2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	—1,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	—1,3	—1,2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	—1,4	—0,7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	—1,6	—0,3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	—1,7	—0,8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	—1,1	—1,3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	—0,5	—0,8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	0,0	—1,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	—0,2	—0,1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	—0,4	—0,2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	—1,2		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	—1,4		[illegible]		[illegible]		[illegible]	[illegible]		[illegible]		[illegible]

differences are not great, and in the second half the curve reaches its highest point. A temperature drop is noted, however, after the August midpoint. From this point on, the average 24-hour temperatures become successively smaller, showing however several returns of waves of warm air masses. Towards the end of October, the curve drops below the average annual value. In the second 10-day period of November, a great temperature drop is noted, and this is the beginning of the pre-winter period. Returns of warm air masses occur up to winter inclusively, and this is noted in the curve by the numerous dips and spikes.

The analysis presented above of the annual course of mean temperatures for a 24-hour period confirms the great temperature variability from day to day at the Hel station.

II. Winds

/8

The wind is a very important element, particularly on the coast. With regard to wind velocities, Gdynia and Hel occupy second place in Poland, immediately after Śnieżka [16]. The most dangerous winds for sailing are winds out of the northeast, north, and northwest. These winds are accompanied by large storm waves [2], catastrophic in their consequences both on the sea as well as on the coast; fortunately, winds from these directions are not frequent.

On the scale of the whole year, it is the westerly winds that are the prevailing ones (Table 11 and Fig. 3), with the exception of Rozewie and Karwia, which show maximum frequencies for southwesterly winds. In general, the western sector is the dominating one. Southerly winds are in second position, whereas the northerly and easterly winds are least representative.

Table 11. Percentage fraction of specific wind directions (1928-1938)

Locale	Year: Direction N	NE	E	SE	S	SW	W	NW	Calms
Hel	9,3	8,1	9,9	12,1	15,2	11,9	16,2	13,3	4,0
Jastarnia	9,7	7,8	9,6	8,0	14,7	11,6	17,4	9,2	12,0
Chałupy	11,8	9,1	10,2	8,2	15,2	15,9	15,9	10,1	3,6
Rozewie	4,3	5,3	6,0	15,7	8,8	20,3	19,3	9,3	11,0
Karwia	7,8	8,1	7,6	13,0	8,2	17,4	17,1	12,5	8,3
Puck	5,3	7,0	10,4	12,8	8,1	16,6	19,9	9,2	10,7
Gdynia	6,3	5,9	7,1	12,6	13,5	13,1	19,7	15,5	6,3

During the spring (Table 12 and Fig. 4), the area studied is an area where various air masses cancel each other out: polar-sea (PPm), polar-continental (PPk), as well as arctic air masses (PA). As a result, the fraction of easterly and westerly winds is of just about the same order, with the exception that on the Peninsula it is the easterly winds that dominate, and on the land it is the westerly winds (in Gdynia, it is the northwesterly winds). Certainly, local conditions have a great influence on these kinds of characteristic determinations of convergent wind directions. Karwia, Rozewie, and Puck are shielded from the west, and this restricts the free flow of westerly oceanic masses, whereas Gdynia is surrounded by hills to the west and it directs the wind away through a streamline basin to the southeast.

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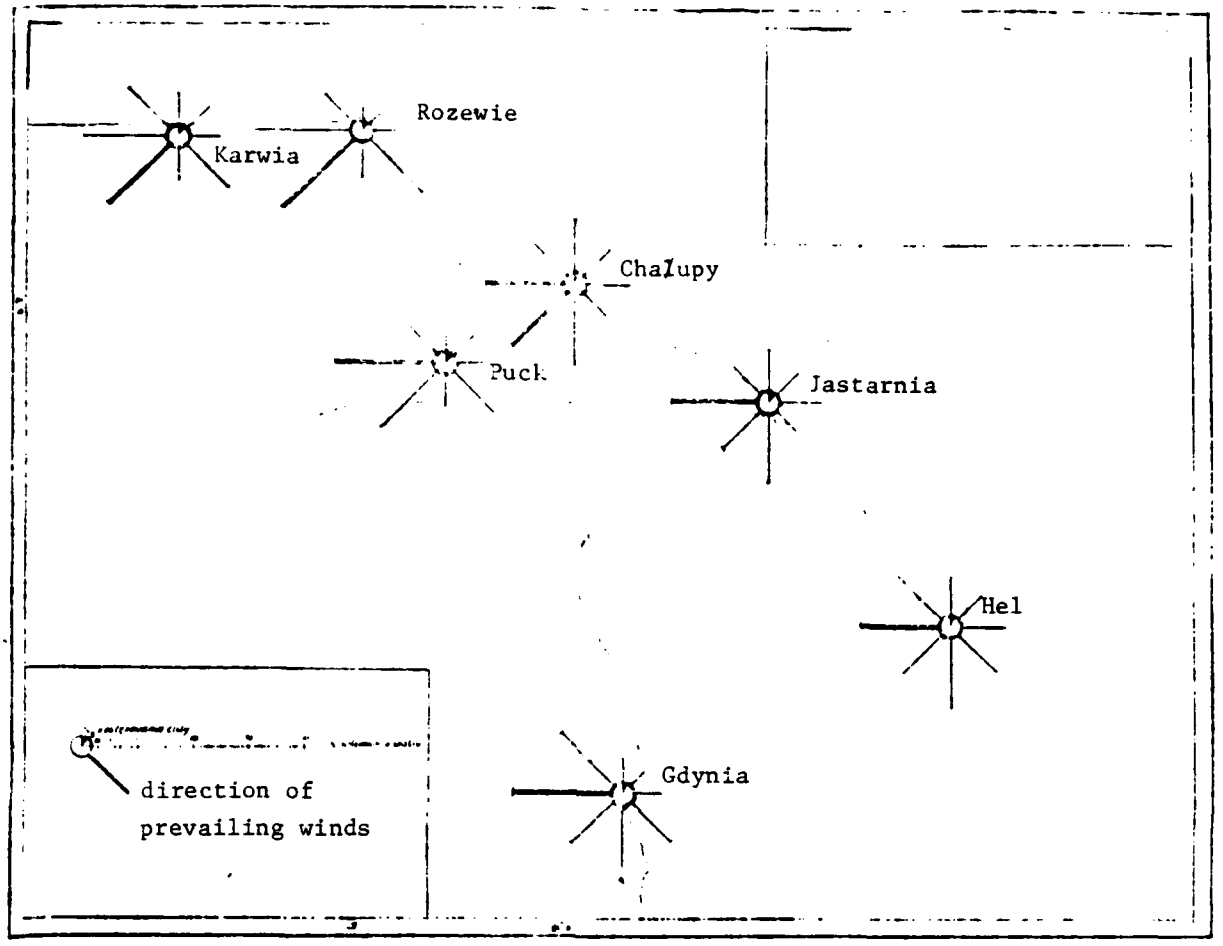
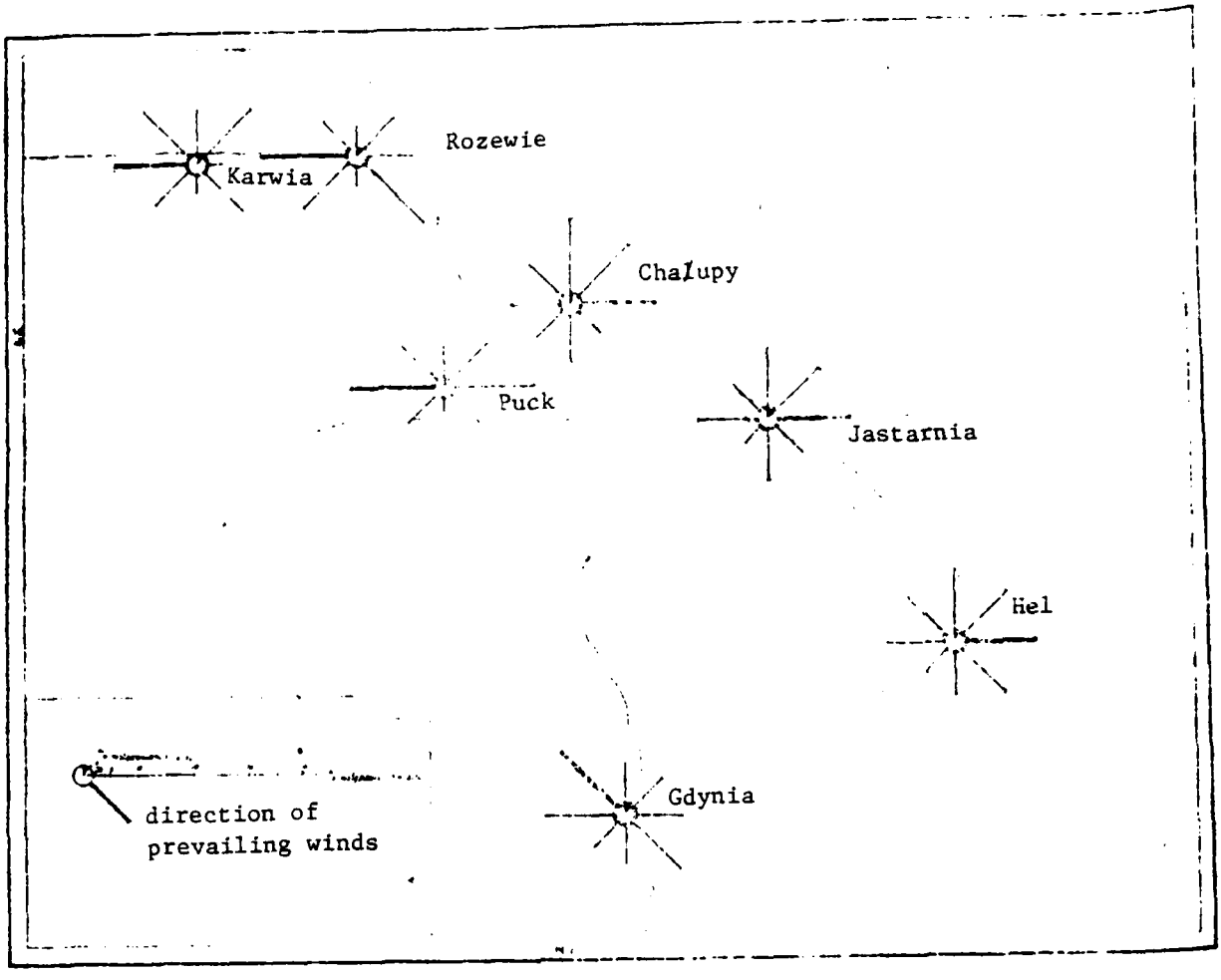


Fig. 3. Wind directions in °/o on the Hel Peninsula and adjacent coast for the year 1928-1938. Yearly.

During the summer (Table 13 and Fig. 5), barely 25% of the overall sum is represented by westerly winds; this indicates the dominance of warm and humid oceanic polar masses (PPm). It is exactly these northerly and northeasterly winds which are unpleasantly perceived in the hottest seasons of the year. Winds from southerly directions are registered most rarely.

The autumn season (Table 14 and Fig. 6), however, shows an increase in southerly winds. The southwesterly direction is the one most often encountered. Westerly winds have a large share, and in Gdynia and Jastarnia, they are the most frequent. The weakest winds are recorded out of northerly, northeasterly, and easterly directions.



/1

Fig. 4. Wind directions in °/o on the Hel Peninsula and adjacent coast for the years 1928-1938. Spring.

Table 12. Percent fraction of individual wind directions (1928-1938)

Spring

Locale	Direction								
	N	NE	E	SE	S	SW	W	NW	Calms
Hel	13,1	13,0	14,5	12,7	9,7	7,6	12,2	12,5	4,8
Jastarnia	12,4	12,5	14,3	8,6	11,1	6,0	12,4	9,2	13,0
Chalupy	15,3	14,8	15,4	7,6	10,7	8,8	12,3	10,5	4,5
Rozewie	9,4	9,6	10,1	17,4	5,4	13,6	17,7	8,5	12,3
Karwia	9,8	13,6	11,5	12,1	5,2	10,3	14,9	13,6	9,0
Puck	7,4	11,2	16,3	11,8	4,6	9,6	17,2	10,7	11,2
Gdynia	9,3	9,3	10,5	11,0	9,0	8,4	14,3	18,4	8,8

The winter (Table 15 and Fig. 7) abounds in southerly winds. On the Peninsula and in Gdynia, it is a southerly wind that prevails, bringing with it warm air masses, occasioning together with the Baltic a mild winter course on the coast. /1

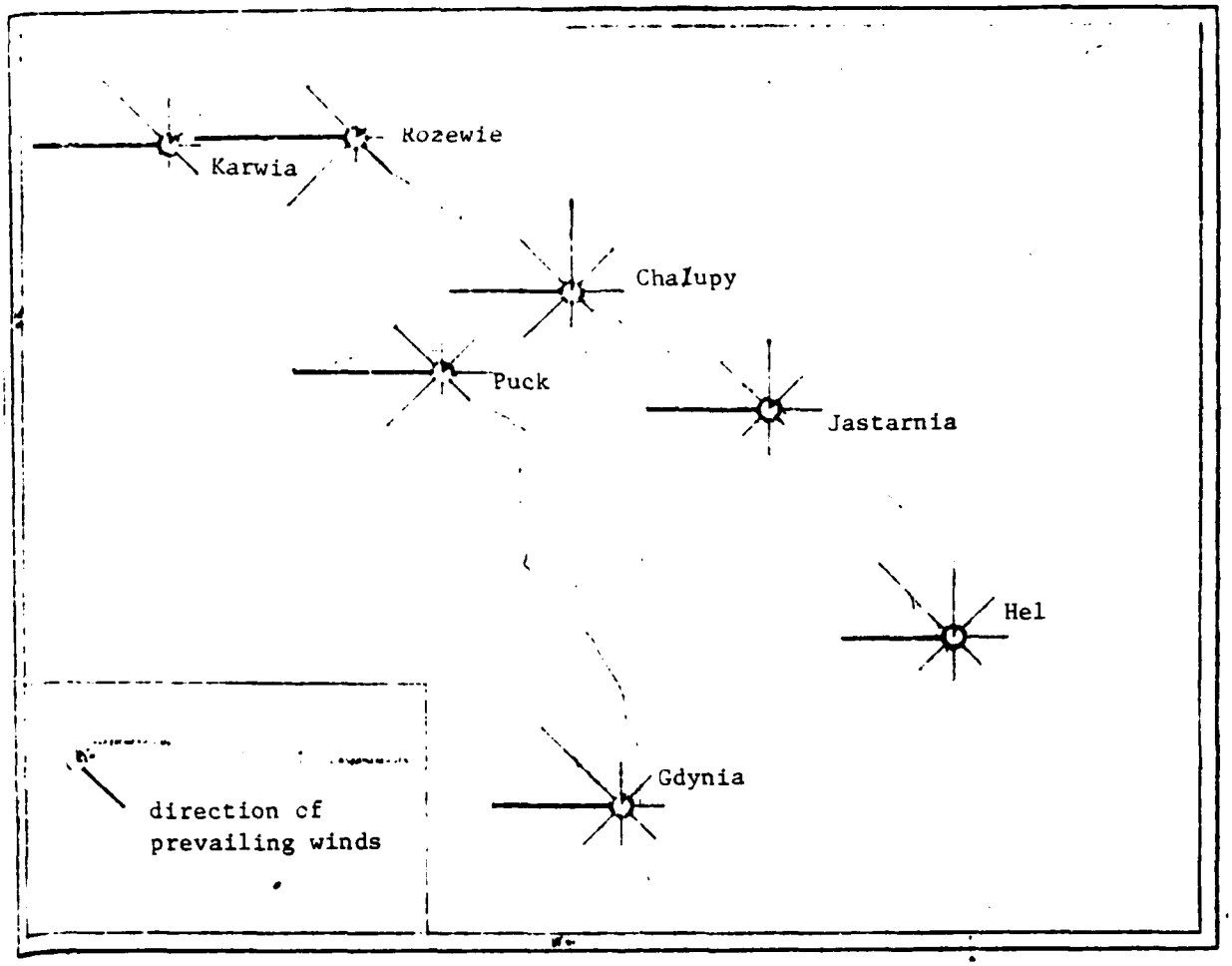


Fig. 5. Wind directions in °/o on the Hel Peninsula and adjacent coast for the years 1928-1938. Summer.

Table 13. Percent fraction of individual wind directions (1928-1938)

Summer

Locale	Direction								
	N	NE	E	SE	S	SW	W	NW	Calms
Hel	12,1	10,1	9,9	7,4	8,3	8,9	19,9	18,6	4,6
Jastarnia	12,3	8,6	9,6	3,8	8,4	7,0	21,7	12,3	15,8
Chałupy	16,5	10,5	9,4	5,2	6,5	12,1	21,8	13,0	5,0
Rozewie	3,5	3,8	5,1	9,1	4,8	17,6	28,4	12,2	15,7
Karwia	8,3	8,0	5,8	7,3	4,3	14,3	21,5	16,4	11,3
Puck	6,3	8,6	9,7	7,0	5,8	13,9	26,4	11,7	12,6
Gdynia	7,8	7,6	7,8	8,7	7,1	10,1	23,0	20,2	7,8

Table 14. Percent fraction of individual wind directions (1928-1938)

Locale	Autumn								
	Direction								
	N	NE	E	SE	S	SW	W	NW	Calms
Hel	6,9	1,7	6,7	12,1	21,1	16,6	16,8	12,3	2,8
Jastarnia	8,1	5,0	6,1	8,5	18,3	16,5	18,7	7,7	11,1
Chalupy	8,8	5,6	7,5	9,1	20,0	22,7	15,0	8,9	2,4
Rozewie	4,1	3,0	3,3	16,2	11,8	26,4	19,4	9,3	9,4
Karwia	7,5	4,8	5,7	13,9	10,7	22,8	14,9	11,1	8,6
Puck	4,4	3,9	6,4	14,3	11,6	24,3	17,7	7,4	11,0
Gdynia	1,4	2,5	4,5	12,3	17,3	18,9	22,1	12,7	4,3

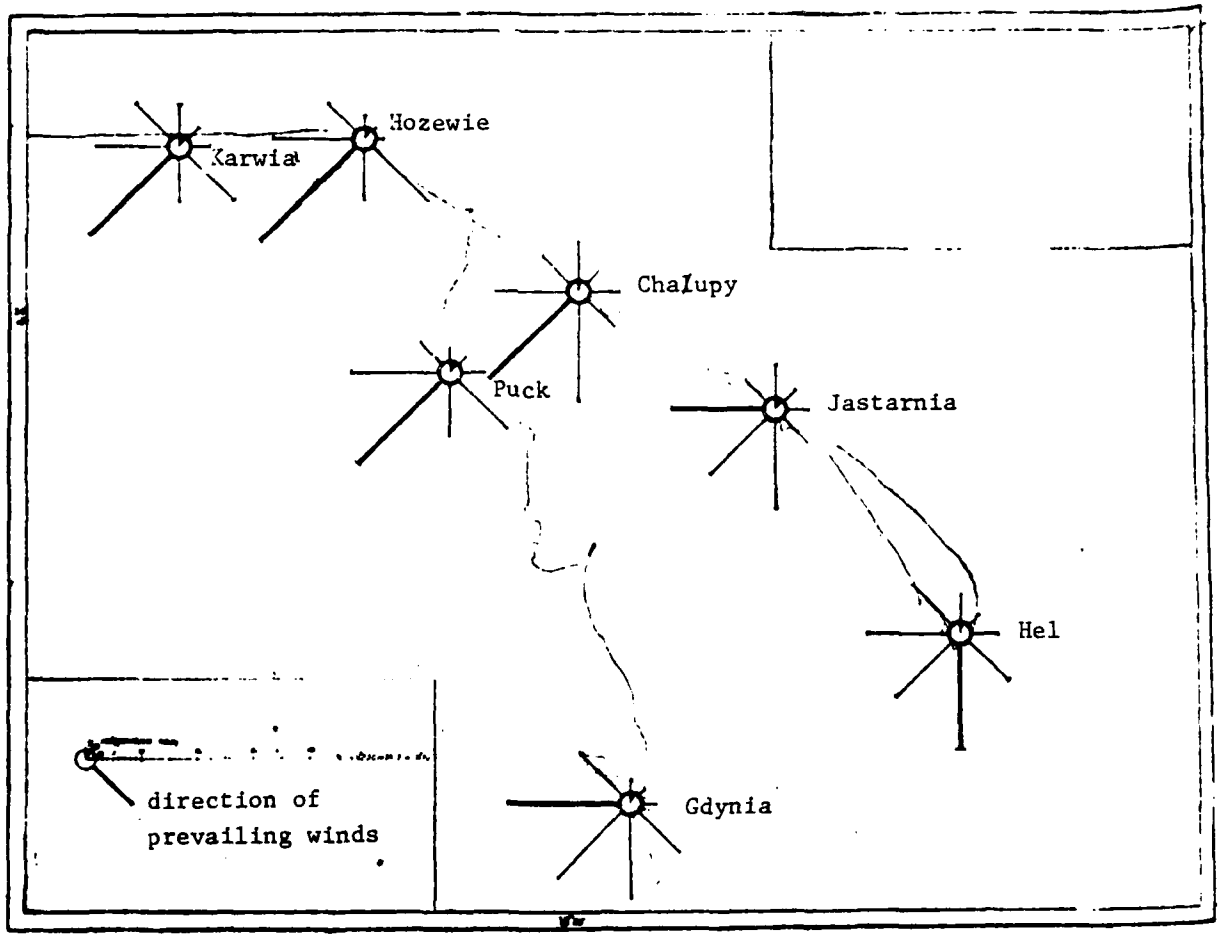


Fig. 6. Wind directions in °/o on the Hel Peninsula and adjacent coast for the years 1928-1938. Autumn.

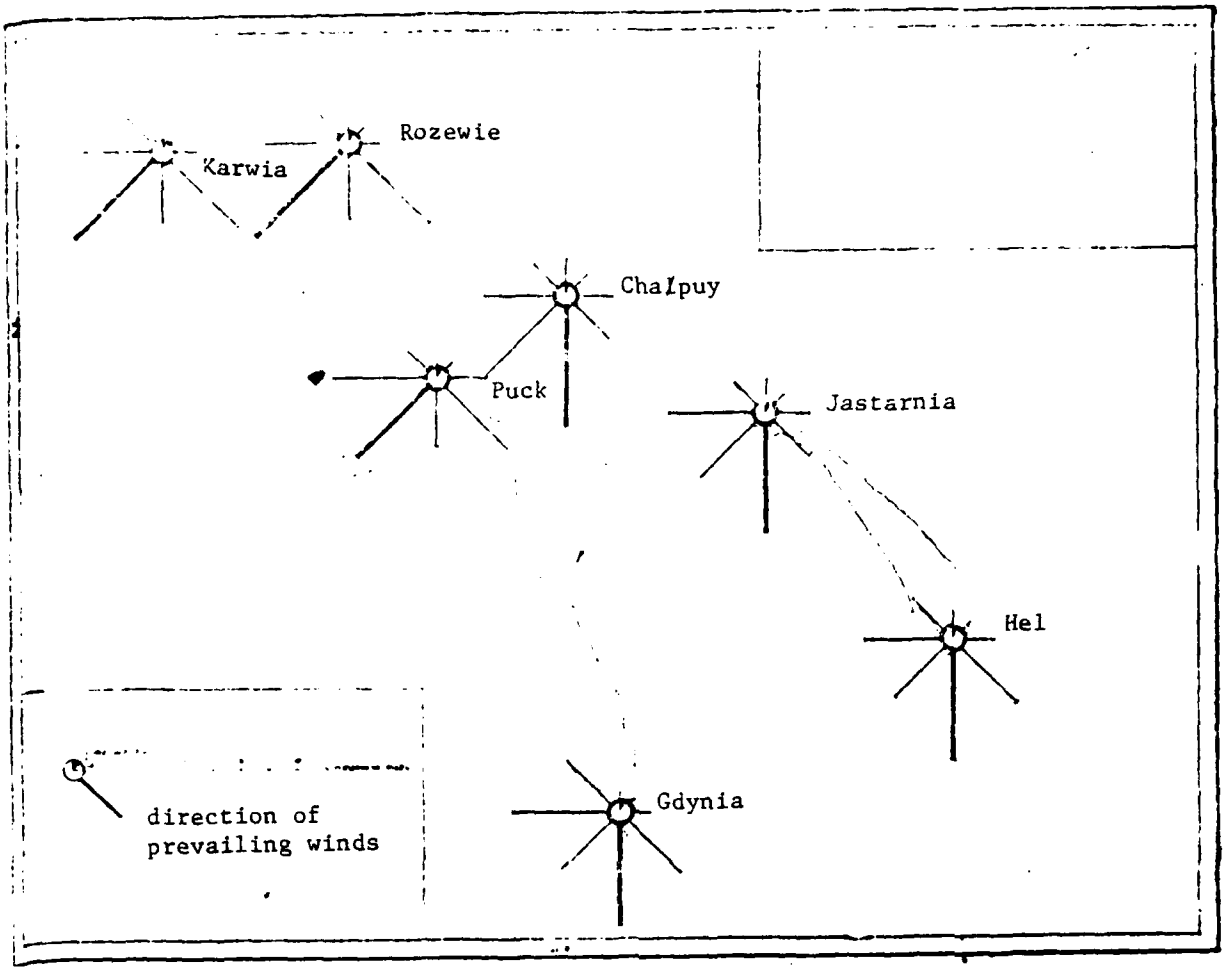


Fig. 7. Wind directions in °/o on the Hel Peninsula and adjacent coast for the years 1928-1938. Winter.

Table 15. Percent fraction of individual wind directions (1928-1938)

Winter

Locale	Direction								Calms
	N	NE	E	SE	S	SW	W	NW	
Hel	5,0	4,5	8,2	16,3	21,9	14,6	15,7	9,8	4,0
Jastarnia	5,9	4,8	7,8	11,2	21,4	16,2	17,0	7,6	8,1
Chalupy	8,6	5,5	8,2	10,8	23,7	20,2	14,6	7,9	2,4
Rozewie	4,2	4,8	5,3	20,2	13,6	23,5	14,9	7,2	6,3
Karwia	5,4	5,8	7,7	19,1	12,9	22,0	14,2	8,7	4,2
Puck	3,0	4,2	3,9	18,0	12,5	20,0	18,5	6,9	8,0
Gdynia	3,5	3,3	5,5	15,3	20,8	15,2	19,1	13,0	4,5

Rozewie, Karwia, and Puck have a prevalence of southwesterly winds. The portion of air masses out of the north, northeast, and east is small.

The portion of calms (Table 16) is shown in percentages in relation to individual seasons of the year. The least number of calms is recorded in Hel and Gdynia during the autumn, whereas for the other stations it is during the winter. The maximum number of calms shown for Hel and Gdynia is during the spring, and for the

Table 16. Percentage fraction of calms in individual seasons of the year (1928-1938)

Locale	Season				Yearly
	Spring	Summer	Autumn	Winter	
Hel	4,8	4,6	2,8	4,0	4,0
Jastarnia	13,0	15,8	11,1	8,1	12,0
Chałupy	4,6	5,0	2,4	2,4	3,6
Rozewie	12,3	15,7	9,4	6,3	11,0
Karwia	9,0	11,3	8,8	4,2	8,3
Puck	11,2	12,8	11,0	8,0	10,7
Gdynia	8,8	7,6	4,3	4,5	6,3

other locations during the summer. On the annual scale, the least number of calms is observed in Chałupy and in Hel, and the greatest number is observed in Jastarnia (data from Jastarnia, as has already been noted, should be taken with certain reservation). It is possible, therefore, to emphasize with strong probability that the Peninsula, in relation to its background, has about 50% less periods of calm.

As far as wind velocities are concerned, it is possible to observe a certain regularity in the monthly averages over the course of a year (Table 17 and Fig. 8). Maxima for the wind velocity are in the winter months, and minima are in May or in the summer months. Wind velocities during the autumn are greater than velocities observed in the spring.

Table 17. Annual course of mean monthly wind velocities in m/sec (1928-1938)

Locale	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	6,2	6,0	5,0	4,7	4,1	4,1	4,1	4,3	4,8	5,8	5,8	6,1	5,1
Jastarnia	4,3	4,0	3,6	3,3	2,4	2,7	2,4	2,8	3,4	4,3	4,1	4,4	3,5
Chałupy	5,1	5,1	4,4	4,0	3,2	3,8	3,6	3,5	4,2	5,0	4,8	5,0	4,3
Gdynia	6,1	6,2	5,2	4,9	3,7	4,3	4,0	4,2	4,6	5,4	5,5	6,3	5,0
Puck	5,5	6,0	5,7	5,1	4,4	4,5	4,3	4,0	4,4	5,2	4,6	5,4	4,9
Rozewie	5,8	5,7	5,0	3,9	3,1	3,6	3,5	3,4	4,3	5,5	5,2	5,7	4,6
Karwia	4,9	5,3	4,3	3,9	3,2	3,8	3,5	3,5	4,1	4,9	4,4	4,7	4,2

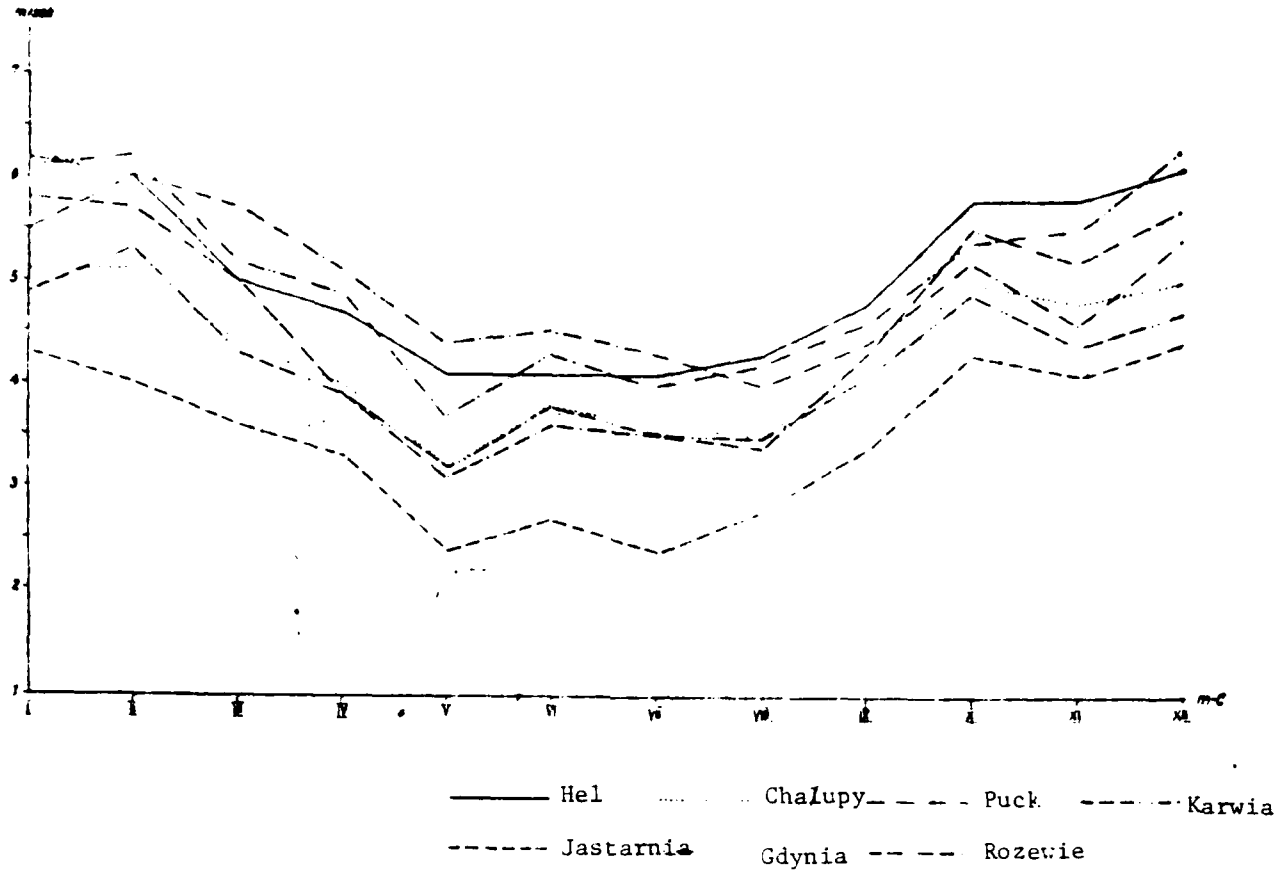


Fig. 8. Annual course of wind velocities in m/sec (monthly means for the period 1928-1938)

The values for extremes in mean monthly wind velocities are assembled in Table 18. The greatest variability in mean monthly wind velocities may be observed in November and December, as well as in February and March. The least variability in wind velocities on the Hel Peninsula occurs during the spring (in April and May), and for the other stations during the summer (with the exception of Rozewie, which is in May). A characteristic feature of the area under study is the occurrence of great absolute wind velocities over the course of almost the whole year.

In almost all months, a wind with velocities greater than 20 m/sec may be observed; however, the winter months and the autumn are unique in this respect. During the summer, great wind velocities occur only sporadically.

Classifying the winds with respect to their velocities into four basic groups, we get the following numerical ratios for the Hel station:

- weak winds (1-5 m/sec): on the average, 631 during the year equals: 60.1%
- moderate winds (6-10 m/sec): on the average, 351 during the year equals: 33.4%
- strong winds (11-15 m/sec): on the average, 46 during the year equals: 4.4%
- very strong winds (16-20 m/sec): on the average, 22 during the year equals: 2.1%.

Table 18. Mean monthly values for extremes of wind velocity in m/sec (1928-1938)

Locale	Month												Yearly
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	8,0	9,1	6,8	6,3	5,2	5,5	5,9	6,8	6,0	8,0	9,7	8,3	5,9
	4,7	4,0	3,3	3,6	3,2	3,2	3,2	2,8	2,5	3,4	4,1	4,5	3,8
Jastarnia	5,8	6,6	5,8	4,4	3,3	4,4	4,2	5,1	5,2	5,8	5,5	6,5	4,5
	3,0	2,0	2,2	2,3	1,7	1,6	1,6	1,5	2,0	2,3	3,1	2,8	2,2
Chałupy	6,5	8,2	6,0	4,9	4,5	5,1	5,3	5,0	5,9	6,0	6,9	8,5	4,9
	3,9	3,1	2,9	3,2	2,0	2,1	2,4	2,0	2,6	3,4	3,6	3,3	3,6
Gdynia	9,0	9,4	8,3	7,3	5,5	6,3	6,4	5,1	6,1	7,2	7,7	9,1	6,4
	4,1	4,0	3,0	3,0	2,6	3,4	2,4	2,7	2,9	3,6	3,8	3,6	3,7
Puck	9,2	8,7	10,7	7,8	6,3	5,7	5,9	5,3	5,3	7,0	6,5	3,3	6,0
	3,6	4,4	3,6	3,0	3,0	3,7	3,1	3,3	2,9	3,9	3,5	2,9	4,1
Rozewie	9,7	9,0	10,2	6,0	4,8	7,0	5,0	6,1	5,6	6,1	6,1	9,7	6,1
	3,2	3,1	2,3	2,1	1,8	2,0	2,0	1,7	2,0	1,7	2,7	2,6	2,9
Karwia	6,5	8,9	6,9	5,2	4,3	6,4	4,4	4,1	5,2	6,2	7,7	7,9	4,8
	2,9	3,3	2,7	2,8	2,0	2,0	2,2	2,6	2,8	3,3	2,7	3,4	3,7

Table 19. Maximum absolute wind velocities in m/sec in the individual months (1928-1938)

Locale	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hel	> 20	> 20	> 20	> 20	20	14	> 20	20	20	20	> 20	20
Jastarnia	> 20	> 20	20	> 20	20	20	> 20	> 20	20	20	20	20
Chałupy	> 20	> 20	> 20	20	> 20	20	> 20	> 20	> 20	> 20	> 20	> 20
Rozewie	> 20	> 20	> 20	17	20	> 20	> 20	20	20	> 20	> 20	20
Karwia	> 20	> 20	20	20	20	20	20	20	20	> 20	> 20	20
Gdynia	> 20	> 20	20	17	17	17	20	17	20	20	20	20

Table 20 gives the annual course of individual wind groups. In Table 21, /1
in addition, the proportions for each of the given wind groups are given for each month. The data from both of these tables concerns the fact that the winter and autumn are periods for the greatest wind intensity with the greatest velocities, and that they are the storm periods that are so characteristic for coastal and sea regions. It is true that the greatest percentage in each month is shown by weak winds (with a maximum in May), but we feel the strong winds much more sharply and for that reason, we give them greater consideration.

Table 20. Percentage distribution of individual wind groups over the course of a year for Hel station (1928-1938)

Winds	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Weak	6.5	6,2	8,7	7,8	10,4	10,1	10,1	9,8	6,9	7,1	7,1	7,3
Moderate	11,4	8,8	8,3	8,8	6,3	6,3	5,9	6,3	6,8	10,8	10,3	10,0
Strong	15,2	10,9	8,7	4,3	2,2	2,1	6,5	6,5	10,9	10,9	10,9	10,9
Very strong	15,9	20,5	9,1	4,5	1,4	.	2,7	3,2	4,5	10,9	9,1	18,2

Table 21. Percentage portion for the given wind groups in individual months for Hel station (1928-1938)

Winds	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Weak	44,8	49,1	61,2	59,1	73,7	73,6	72,2	70,7	65,1	49,8	51,1	51,1
Moderate	43,7	39,0	32,2	37,3	24,9	25,3	23,7	25,1	27,9	42,0	40,9	38,9
Strong	7,7	6,3	4,4	2,4	1,1	1,1	3,4	3,4	5,8	5,5	5,7	5,6
Very strong	3,8	5,7	2,2	1,2	0,3	.	0,7	0,8	1,2	2,7	2,3	4,4

If we take the 16-direction scale for the strong winds and the very strong winds, we come up with the situation given in Table 22. It turns out that the winds of this group fall for the most part among the westerly, west-northwesterly, and northwesterly winds. About 9% of them blow from the southeasterly direction, and somewhat lower than this value are the winds from the southwest and west-southwest, with the remaining storm wind directions occurring very rarely, if the possibility of their existence occurs at all.

The distribution of wind velocities and wind directions as values for the mean monthly velocities and directions are presented in Table 23 and Fig. 9.

Table 22. Percentage proportion and number of wind groups at Hel station.

Wind direction	Strong winds number		Very strong winds number	
N	1,4	3,0	0,5	2,3
NNE	0,9	1,9	0,1	0,5
NE	2,1	4,6	0,2	0,9
ENE	0,7	1,5	0,1	1,3
E	2,3	5,0	1,4	6,4
ESE	2,2	4,8	0,8	3,6
SE	4,1	8,9	2,0	9,1
SSE	2,4	5,2	1,3	5,9
S	2,5	5,4	1,7	7,7
SSW	1,9	4,1	0,4	1,8
SW	3,4	7,4	1,4	6,4
WSW	3,4	7,4	1,0	4,5
W	8,3	18,1	5,4	24,6
WNW	4,6	10,0	2,0	9,1
NW	4,4	9,6	2,3	10,4
NNW	1,4	3,0	0,5	2,3

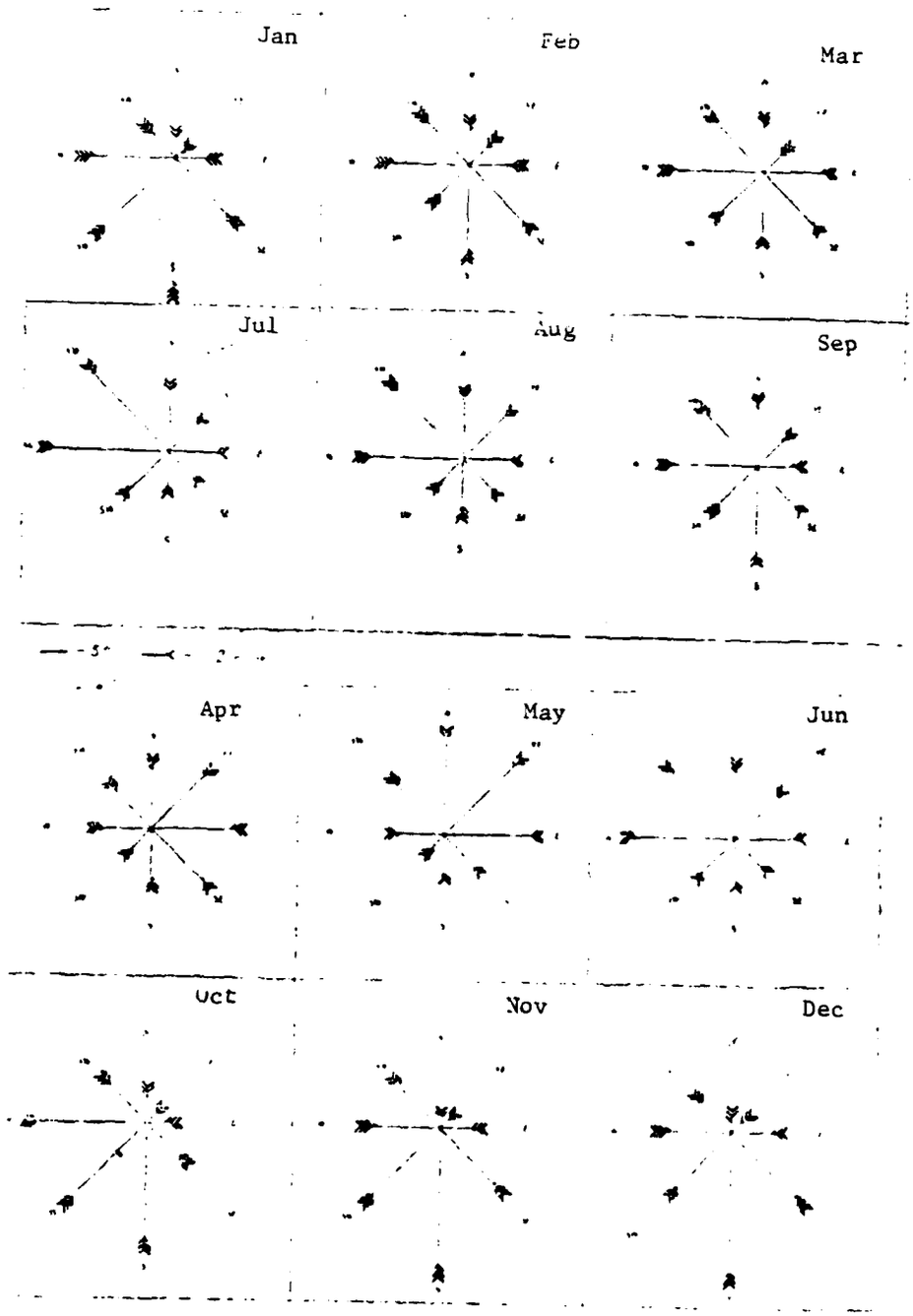


Fig. 9. Wind roses for Hel station (for the period 1928-1938).

Table 23. Percentage portion as well as mean wind velocities in m/sec for Hel station (the values are given for each month of the year in the period 1928-1938)

Month	Portion	Velocity in sec	Direction and force of wind: Portion	NE Veloc. in sec	Portion	E Veloc. in sec	Portion	SE Veloc. in sec	Portion	S Veloc. in sec	Portion	SW Veloc. in sec	Portion	W Veloc. in sec	Portion	NW Veloc. in sec	Calms %
January	3,7	3,9	2,8	4,6	6,7	5,8	15,7	6,8	23,6	6,6	18,8	5,8	16,9	6,9	8,2	6,1	3,6
February	7,8	4,5	6,5	5,4	9,3	6,2	15,1	4,7	16,0	4,9	9,3	5,5	17,7	6,9	12,5	5,8	5,8
March	9,6	4,6	6,5	5,4	11,5	4,8	14,8	4,3	12,9	4,0	11,2	4,6	17,2	5,9	13,0	4,7	4,0
April	12,0	4,6	14,2	4,8	15,2	4,9	14,6	4,2	9,1	4,3	6,7	4,6	10,1	5,2	10,8	5,0	6,8
May	17,8	3,8	18,4	4,1	16,0	3,8	8,8	3,2	7,5	3,3	4,8	4,7	9,3	4,5	13,6	5,0	3,8
June	12,9	3,0	11,2	3,3	11,1	3,3	7,5	3,1	8,3	3,0	9,0	3,6	19,5	5,1	17,4	4,4	3,1
July	11,7	4,0	7,7	2,8	9,1	3,0	6,6	3,3	6,9	3,9	10,7	4,5	21,9	5,2	20,2	5,1	5,2
August	11,6	3,9	11,5	3,5	9,5	4,0	8,2	3,4	10,2	3,7	7,1	4,5	18,3	5,6	18,0	5,7	5,6
September	11,8	4,5	7,8	4,2	7,7	4,4	10,9	4,3	16,0	4,3	11,3	5,7	16,2	5,9	13,8	5,0	4,5
October	6,1	4,3	3,6	3,9	5,4	4,8	9,7	5,5	21,4	5,3	19,9	6,0	20,6	6,9	11,2	5,9	2,0
November	2,9	3,9	2,9	3,6	7,2	5,4	15,9	6,2	25,6	5,5	18,6	5,6	13,5	6,1	11,8	5,2	1,6
December	3,8	5,0	4,3	4,5	8,7	4,4	17,9	6,7	25,8	5,7	15,2	5,5	12,6	6,7	9,1	5,4	2,6

In this array as well, one's eye is drawn to the greatest portion of winds out of directions with westerly components for almost all the months. At this point, we shall take up the characterization of the individual months.

January. The greatest frequency is shown here for southerly winds with average velocities of 6.6 m/sec, and the southwesterly winds come next. The portion of winds out of the west and southeast with identical mean monthly velocities of 6.8 m/sec is quite high. Winds out of the north and northeast are least attested, and they are relatively weak.

February. Westerly winds dominate for the month of February as regards frequency of occurrence (17.7%) and as regards velocities of 6.0 m/sec. Southerly winds are in second place, followed by southeasterly winds. Northerly and northeasterly winds occur more often than in January, but they are by far the rarest in this month.

March. In March, a very decided portion of westerly winds may be observed. Southeastly and northwesterly winds follow in their frequency of occurrence. The northerly and northeasterly winds are weakest in this sequence.

April. In April, it is winds with an easterly component, that is, easterly, southeasterly, and northeasterly winds which predominate; however, with respect to velocity, the strongest are westerly and northwesterly winds. In distinction to the previous month, the southwesterly and southerly winds occur most rarely, and southerly winds are a more frequent phenomenon than westerly winds.

May. Winds out of northeasterly, northerly, and easterly, as well as northwesterly directions predominate in May. The other wind directions occur significantly more rarely.

June. In June in the next sequence, the portion of northerly winds with mean velocities of 5.0 m/sec is significant, although the most frequent are westerly winds (5.1 m/sec), followed by northwesterly winds (4.4 m/sec).

July. The situation in July is similar to the one in June, with the exception that it is the westerly and northwesterly winds that have a higher percentage share; this is shown in the numbers 21.8% and 20.2%, the largest not only for the monthly scale, but also the annual scale. In addition, the number of northerly winds is significant. The southeasterly and southerly winds are most weakly noted.

August. In August, it is westerly and northwesterly winds that are the most frequent, but the westerly and northwesterly winds decrease in their percentage portion for a gain in the northeasterly and southerly directions. Northerly winds are quite frequent.

September. The portion of northerly winds is similar to the number in August; however, westerly winds, as well as northwesterly winds, despite the fact that they are most frequently represented, lose their significance in terms of numbers, and as a consequence, there is an increase in the percentage portion of southerly winds. Northeasterly and easterly winds show the least frequency.

October. In October, the southerly winds are the highest. Westerly and southwesterly winds are noted to a slightly smaller extent. Northeasterly and northerly winds have only a small portion.

November and December. In November and December, winds with a southerly component

are the prevailing ones, that is, southerly, southwesterly, and southeasterly. Westerly winds show a significant frequency, and northerly and northeasterly winds are a rarity.

III. Pressure

Pressures on the Hel Peninsula reach high values. The mean annual value (in terms of real levels) for Hel is 760.6 mm (Table 24). Over the course of a year, the mean monthly value reaches a high in December and a minimum in April. In absolute extremes, the maximum pressure falls in December, amounting to 787.1 mm. In addition, the absolute minimum is noted in January at a value of 721.2 mm.

Table 24. Mean monthly pressures in millimeters for Hel station (1931-1938)

Locale	Month												Yearly
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel Hp 4.4 m	762.2	759.4	760.3	758.6	761.4	760.6	759.1	760.3	761.0	753.9	762.3	762.6	760.7

The numbers given above, however, do not at all present a representative picture of the yearly pressure course in the area under study. For the purpose of gaining a picture for the course of this element, consecutive curves for the Hel weather station have been plotted, taking as the basis the mean pressures for a 24-hour period from three consecutive days (Fig. 10).

Taken generally, this curve possesses a form close to a sinusoidal one with very irregular periods, as well as differing fluctuations in the amplitudes. The amplitudes are greatest in the winter months, and the curve reaches a high point in December at day 22. After this maximum, there follows a deep depression (day 3 of February, a second order minimum). The second-order maximum on day 19 of November precedes a steep pressure drop before the third day of December, if we eliminate the small disturbances in the curve in the region for the 26th to the 29th of November. The continuous curve does not indicate, however, the lowest point in the above-cited lows. This minimum is noted on the 29th day of October. The smoothest course is shown for the curve in May. In June, July, and August, it has a somewhat varied character, but beginning with September, it begins to fluctuate considerably, at first over a small

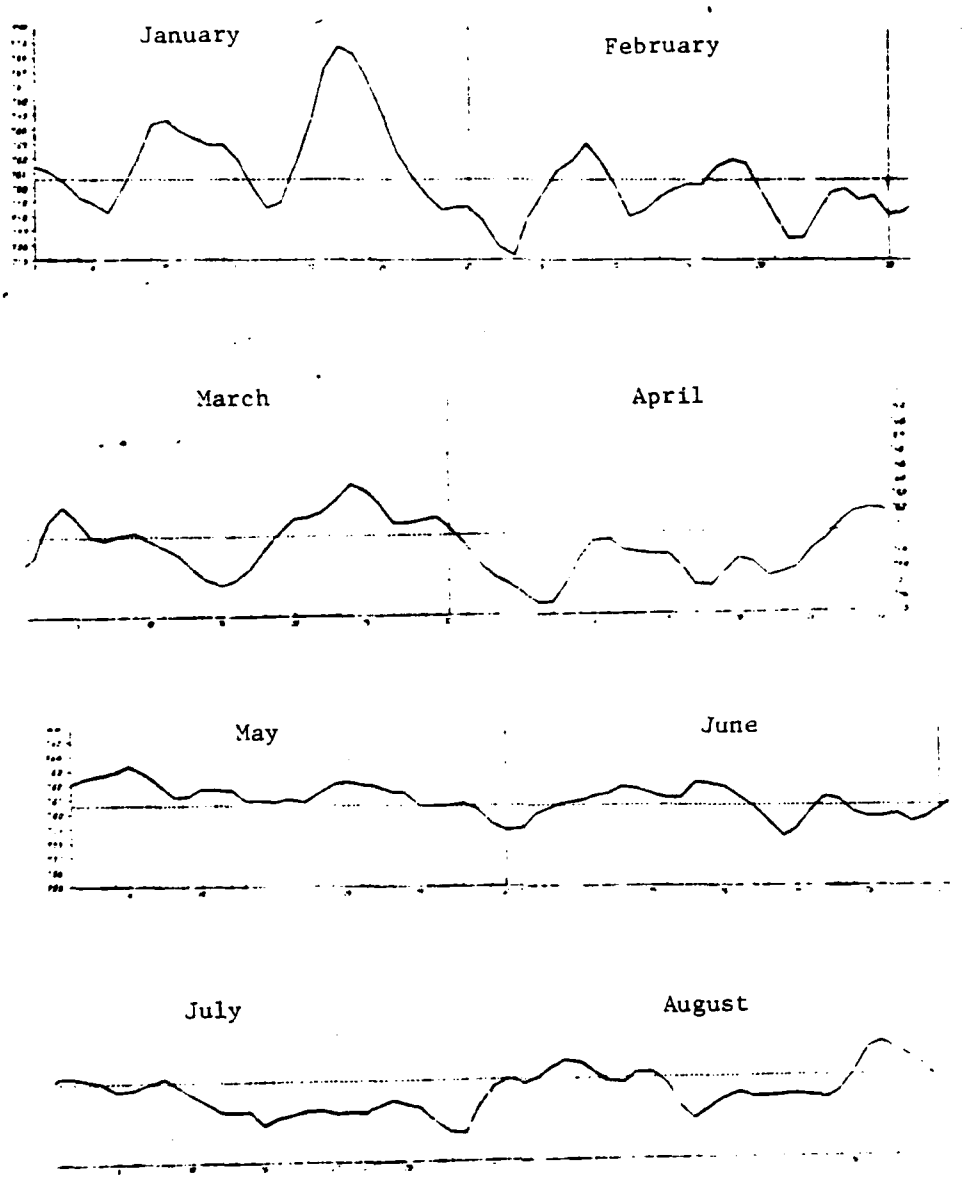


Fig. 10. Continuous curves for the course of pressure over 24-hour periods for Hel station (for the period 1931-1938).

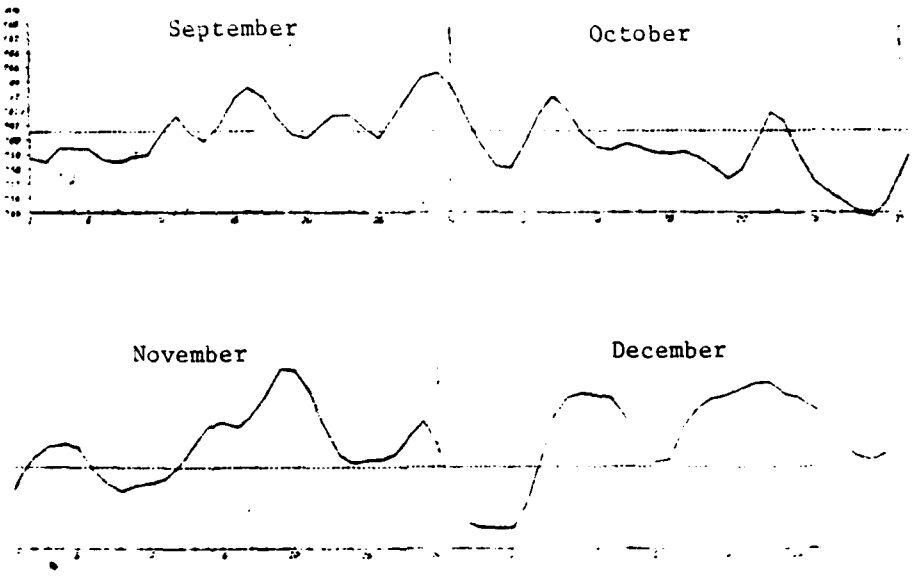


Fig. 10 Cont'd.

period, which then in October and November is expressed very well. The course of the pressure curve in March and April is much more moderate than in the winter months, but in comparison with the curve from May, it has a greater number of bends.

In connection with the mean annual values, shown in Fig. 10 by the broken line, it is only in April and July when the pressure falls lower than this value; in May, the course of pressure is above the mean annual, and in the rest of the months, it often crosses this value both in the plus as well as minus directions.

IV. Precipitation

Precipitation, which is an important typological measurement of climate, reaches in our series of observations on the Hel Peninsula, yearly sums from 465 mm (at Jastarnia) to 551 mm (at Hel). The nearest coastal section has somewhat more rain than this. The data from Gdynia diverge only by a little from the values for Hel, that is, by only 7 mm on the plus side. In Puck, on the other hand, there are only 570 mm of precipitation noted annually, and in Karwia 645 mm.

As may be seen from a map (Fig. 11), the high of the yearly sums decreases in the direction toward the sea. In addition, the orographics of the terrain, as well as differences in the thermal conditions of the surface, have a decisive effect on

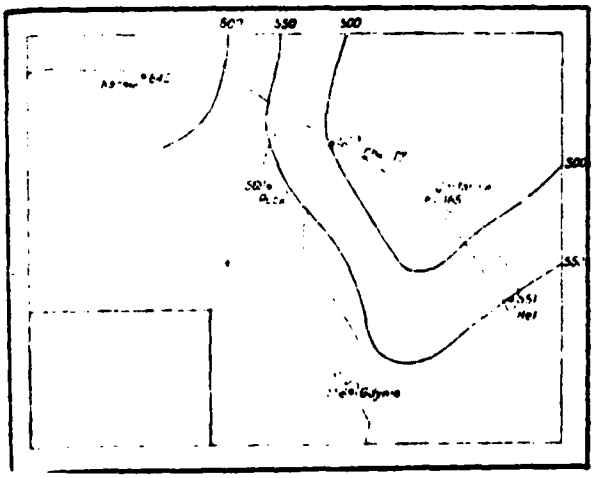


Fig. 11. Yearly amounts of precipitation in mm.

the drop in precipitation highs over the area of the sea. The water vapor contained in the air condenses on the windward side of the moraine hills, but it is also true that the sea region is a terrain with less intense currents. From this, the

isohyets show a drop in value in the direction of the sea.

Table 25 and Fig. 12 show the amounts of precipitation recorded in individual months of the year in percentages of the yearly amounts. The minimum precipitation falls in the month of January. In general, the winter season is the poorest in precipitation. The maximum for all the months occurs in July. Around 60% of the annual total atmospheric precipitation falls in the months from June to October inclusively. In general, the course of precipitation in the area studied is not typical for a sea climate.

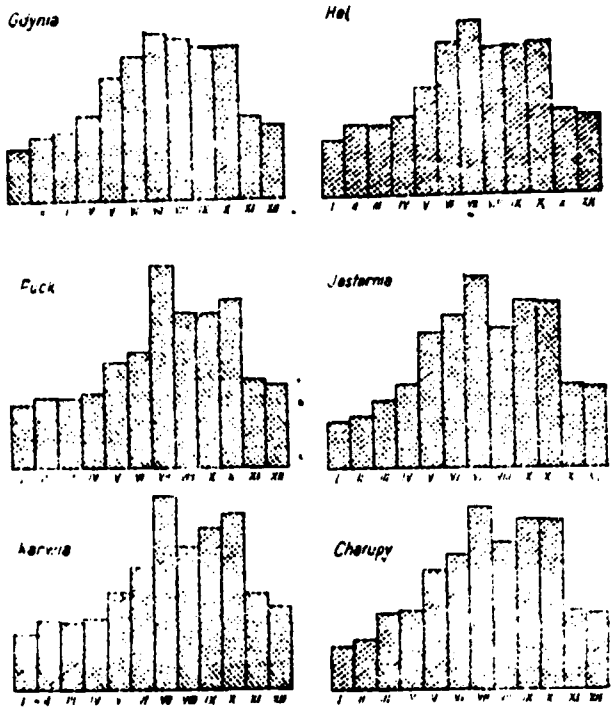


Fig. 12. The course of precipitation for the period of a year (monthly amounts in percentages of the yearly amount) (1928-1938).

When we consider the number of days with precipitation (Table 26), it can be seen that the mean for the winter season differs only slightly from the number of days in a season that has much rain. This fact, which is characteristic for the course of precipitation in the winter, in the late fall, and even in the early spring, comes about as a result of the rainy weather (the so-called "szaruga," "bad weather, squall"). The unconditional maxima for the number of days with precipitation show no difference between the seasons mentioned above, with the exception of May which has the least number of days of precipitation over the annual course. On the scale of the whole year, the least number of days with precipitation is recorded

Table 25. Yearly amounts of precipitation in millimeters, as well as monthly amounts in percentages of the yearly amounts (1928-1938)

Locale	Yearly amount	Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hel	651	4,3	5,8	5,2	6,0	8,1	11,5	13,1	11,1	11,3	11,6	6,1	6,0
Jastarnia	605	4,5	5,0	5,0	5,8	10,0	11,1	14,1	10,2	12,3	12,2	6,0	5,7
Chałupy	710	5,1	5,0	5,8	5,9	9,0	10,0	13,9	11,0	12,8	12,7	5,9	5,7
Gdynia	578	3,9	5,0	5,2	6,1	9,2	10,8	12,7	12,1	11,5	11,4	6,3	5,5
Puck	609	4,6	5,1	5,3	5,5	7,7	8,4	15,0	11,6	11,5	12,4	6,5	6,3
Karwia	645	4,...	5,2	5,1	5,5	7,4	9,1	14,4	10,7	12,2	13,0	7,2	6,1

in Jastarnia (125), followed by Karwia (135). The greatest annual high for precipitation in Karwia may be interpreted, therefore, as the greater intensity of this element in relation to the other locales. Hel, Chałupy, Gdynia, and Puck show about 150 days per year of precipitation.

The absolute highs for the maximum for a 24-hour period in the individual months are shown in Table 27. The maximum 24-hour period values for precipitation were noted in June, July, and August. The greatest 24-hour period of precipitation of all the observed locales achieved a value over 50 mm. Gdynia alone recorded on the 3rd day of August 1932 in the morning hours a torrential rainfall with a high of 119.1 mm with winds out of the east and northeast with a slight drop in pressure (from 758.4 to 755.7 mm).

Table 26. Mean and maximum number of days with precipitation (1928-1938)

Locale		Month												Year
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	mean	14	13	11	12	11	10	14	11	13	15	13	13	150
	max.	23	19	21	18	15	17	20	19	20	22	18	20	189
Jastarnia	mean	9	10	10	9	9	10	12	9	11	13	11	11	125
	max.	21	19	17	17	11	16	19	14	20	22	14	19	174
Chałupy	mean	11	11	11	11	11	11	13	10	13	17	12	12	145
	max.	19	17	19	16	16	16	18	19	21	24	23	19	182
Gdynia	mean	13	14	11	13	11	11	14	11	14	16	12	14	154
	max.	22	19	22	18	16	16	20	17	20	23	21	22	209
Puck	mean	14	15	12	13	10	10	14	11	15	16	14	15	159
	max.	22	23	22	18	15	18	18	20	22	24	20	21	185
Karwia	mean	12	11	10	10	8	10	12	9	13	15	13	12	135
	max.	21	18	19	14	14	17	16	12	19	22	20	19	155

Table 27. Absolute high of maximum precipitation for a 24-hour period (1928-1938)

Locale	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hel	11,3	15,2	31,2	17,0	25,9	56,7	53,2	37,2	39,5	29,6	12,2	16,1
Jastarnia	16,3	12,5	30,6	16,7	44,2	39,6	46,0	25,3	26,1	28,1	13,2	13,9
Chalupy	18,2	13,2	21,9	15,2	24,3	53,2	12,3	14,7	34,8	29,4	12,2	25,8
Gdynia	12,5	15,1	30,9	19,6	30,7	40,9	38,7	119,1	31,9	35,7	21,7	15,0
Puck	10,9	21,4	32,9	13,9	34,0	47,5	52,7	54,6	30,3	39,2	16,8	18,8
Karwia	11,2	24,6	17,5	17,5	54,0	51,3	57,5	43,2	39,6	28,4	18,2	23,9

Fluctuations in the precipitation highs in the individual months for the 11-year period (Table 28) are considerable, particularly in December, February, and March, and during the rainy season in August; on the other hand, July shows the least divergence in this respect. In the remaining months, the precipitation behaves in a variable manner.

At the Hel station, there are five months for the period under study in which the overall amount of precipitation recorded was less than 25% of the mean perennial amount (January, February, March, June, August), and there were five months in which the amount of precipitation was higher than 200% of the mean perennial amount. Gdynia has only three months with amounts less than 25% of the mean value and seven months higher than 200% of this amount. In Karwia, these values are respectively three and six months. From this, it emerges that both dry periods (lower than 25% of the mean perennial value), as well as periods of great precipitation (over 200%) are very rare on the coast.

Variability in precipitation from year to year is also not too accentuated. Extreme values for Hel station are seen (Table 28) in the numbers 705 mm and 417 mm, which amount to 128% and 76% of the mean perennial amounts. A similar situation arises in other locales. In general, the year most abundant in precipitation shows an amount twice as high as the year with least precipitation.

We shall now take a look at snow precipitation whose average on extreme dates of first fall and last fall are shown in Table 29. The average period in which it is possible for snow to fall in the section of the coast under study here lasts from the third 10-day period of November until the beginning of the second 10-day period in April. In Karwia, this period is shorter by about 20 days. The earliest recorded

Table 28. Maximum and minimum precipitation amounts for individual months of the year (1928-1938)

Locale		Month												Year
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	Max	46	39	63	47	123	122	151	140	98	121	58	78	705
	Min	4	4	5	21	16	8	30	14	29	37	15	11	417
Jastarnia	Max	37	40	38	49	105	107	126	82	88	140	51	73	702
	Min	3	1	3	3	12	14	28	6	10	26	9	4	320
Chałupy	Max	34	32	92	44	110	94	129	120	106	124	46	73	650
	Min	3	4	3	5	18	13	20	12	25	24	10	9	372
Gdynia	Max	50	45	64	39	113	99	101	162	107	142	74	71	726
	Min	5	6	9	10	23	18	27	9	30	20	11	11	439
Puck	Max	55	60	63	55	124	91	127	155	109	150	77	71	716
	Min	5	13	8	8	13	10	24	10	36	15	11	9	337
Karwia	Max	56	64	82	60	122	91	184	94	113	162	95	97	861
	Min	8	15	12	9	9	14	48	12	52	28	9	14	560

Table 29. Average and extreme dates for the first and last snowfalls (1928-1938)

Locale	Average snow date		Period without snow	Extreme dates for snowfall	
	Last	First		The latest	The earliest
Hel	11 Apr	29 Nov	232	28 Apr 1929	26 Oct 1931
Gdynia	12 Apr	23 Nov	225	30 Apr 1935	27 Oct 1931
Karwia	1 Apr	10 Dec	253	30 Apr 1935	11 Nov 1933

Table 30. Mean number of days with snow cover and the maximum number of days with continuous snow cover (1928-1938)

Locale		Month							Yr
		I	II	III	IV	X	XI	XII	
Hel	mean	13	14	9	1	.	0,5	3	44
	max.	31	28	28	1	.	2	18	
Gdynia	mean	13	15	8	1	.	1	10	48
	max.	31	28	24	5	.	6	16	
Karwia	mean	13	13	8	0,1		0,4	6	40
	max.	31	28	22	1		2	13	

was a snow on the 26th day of October at Hel station, the 27th of October in Gdynia, and the 11th of November in Karwia. The latest date for a snowfall falls on the 30th of April.

The number of days with snow during the year amounts to on the average a little bit more than 30 days for Hel station and Gdynia station, whereas Karwia has 25. With regard to the absolute values, in the year 1937, about 50 days with snow were noted for all stations. The highest mean monthly number of days with snow is shown for February (7-10).

The snow cover is a function of snowfall and temperature. The mean number of days with snow cover (Table 30) indicates that the optimal conditions for the occurrence of this phenomenon arise in February and January. In the rest of the months, snow cover occurs only sporadically. The longest period with a continuous snow cover was recorded from January to March 1929. The relationships predominating in this exceptional year cannot, however, be a basis for generalizations about the other years. When we eliminate the data from the year 1929, then the continuous snow cover lasted somewhat more than 20 days (in the month of January).

V. Humidity

Relative humidity on the coast shows high values (Table 31). Hel station records an average relative humidity greater than 80% for all months, with a maximum in November, December, and January (87%) and a minimum in June. The mean annual relative humidity for Hel station is greater than the mean annual value for Gdynia. The minimum humidity occurs in Gdynia, also in June with 72%, and a maximum in December with 87%.

Table 31. Mean monthly relative humidity (1928-1938)

Locale	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	87	83	83	81	81	80	83	84	83	85	87	87	84
Gdynia	86	83	80	78	75	72	76	79	79	81	84	87	80

The percentage ratio of individual values for the relative humidity for the given months is presented in Table 32. The highest proportion of all the months, with little exception, is humidity in the range 90-99%. After that, values of 80-90% and 70-80%. These three classes hold for a total of 84.7% of the observations. In no month was humidity recorded less than 10%. The lowest is the value in January and October holding in the 40-50% interval, and in November and December at 50-60%.

Table 32. Percentage portion of individual relative humidity values in the given months of the year for Hel station (1928-1938)

Month	Humidity									
I				0,1	0,6	2,8	11,9	37,3	45,3	2,0
II	0,1	0,7	0,5	1,6	[illegible]	8,5	[illegible]	[illegible]	[illegible]	[illegible]
III		0,3	0,5	1,4	[illegible]	9,6	15,0	23,5	36,7	2,6
IV			0,1	[illegible]	[illegible]	11,9	18,0	[illegible]	[illegible]	[illegible]
V		0,1	0,4	1,7	6,3	[illegible]	19,6	[illegible]	[illegible]	2,0
VI			0,5	1,7	7,1	11,6	[illegible]	31,0	23,8	4,9
VII			0,1	0,5	[illegible]	8,8	[illegible]	36,3	[illegible]	[illegible]
VIII				0,3	4,9	10,4	15,8	28,5	38,8	1,5
IX		[illegible]		0,4	3,7	[illegible]	19,4	27,0	35,0	2,1
X				0,1	[illegible]	8,1	19,0	[illegible]	[illegible]	[illegible]
XI					0,7	4,1	[illegible]	36,4	41,2	[illegible]
XII					0,4	[illegible]	[illegible]	[illegible]	[illegible]	0,9
Yearly	0,0	0,1	0,2	0,8	[illegible]	[illegible]	16,9	32,1	[illegible]	[illegible]

It is necessary in all aspects of life on the coast to take into account the high air humidity.

VI. Cloud Conditions

The greatest cloud cover is recorded in December. The winter period prevails with its high cloud cover values over the remainder of the year. November as well should be included in the class of those months having a great amount of cloud cover. The minimum cloud covering is shown by June with an average over 50%. In general, in the period from May to September inclusively, it is possible to observe cloud covering amounting to not more than 50% of the sky; in March, April, and October, this is over 60%, and in November and the winter months it is about 80%.

Relying on the values for the three observation terms of the local weather, the course of cloud cover for 24-hour periods is the following: at Hel, the greatest values are recorded in the early morning and the smallest values in the evening; in Gdynia, the cloud cover from 0700 and 1300 hours is the same, and in the evening it is lower; in Karwia, in addition, the minimum is recorded at noon. In the compilation of the number of clear days and cloudy days, the prevalence in the number of these latter is striking. Spring has the most clear days (in Karwia in the summer), and the least number of them occur in the winter, during which cloudy days dominate.

The summer has the least number of overcast days, but the number of them (in Gdynia and in Hel) is almost twice as great as the number of clear days. Karwia is an exception; here, this relationship is clearly contrary, for it has 25 clear days and 12 overcast days.*

Table 33. Course of mean monthly cloud cover over the period of a year (1928-1938)

Locale	Month												Yr
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	7.7	7.6	6.3	6.2	5.4	5.1	5.7	5.6	5.5	6.8	7.4	8.3	6.5
Gdynia	7.6	7.6	6.2	6.3	5.8	5.4	6.0	5.6	5.5	6.6	7.2	8.0	6.5
Karwia	6.6	6.8	5.5	5.1	4.9	4.0	4.6	4.5	4.8	5.8	6.4	7.4	5.5

Table 34. Mean annual cloud cover for specific observational periods (1928-1938)

Locale	Observation period		
	7 hours	13 hours	21 hours
Hel	6.8	6.5	6.0
Gdynia	6.8	6.8	5.9
Karwia	6.0	5.0	5.3

Table 35. Number of days of clear weather and cloudy weather in the individual seasons (1928-1938)

Season	Hel		Gdynia		Karwia	
	Clear	Cloudy	Clear	Cloudy	Clear	Cloudy
Spring	12	28	10	29	20	20
Summer	13	18	10	20	25	12
Autumn	8	31	8	31	13	23
Winter	4	52	3	51	7	40
Yearly	37	129	31	131	64	95

The number of cloudy days during which the sky is covered by clouds varies /2 from 20% to 80%,** but there are more of them. The spring, summer, and autumn

*This peculiarity of Karwia in the course of cloud cover must be interpreted in accordance with local conditions. The station was set up in a forest. It is certain that the discrepancies in observation result arise from this.

**On the 11-point scale used in meteorological practice, this cloud cover rate is expressed by the numbers 2 to 8.

seasons have these kinds of days about 70% of the time, whereas in the winter, we have cloudy days somewhat over 50% of the time.

In general, it is possible to confirm, as a result, that the extent of cloud cover over the area under study is quite variable. It is only in the winter when the more intensive cloud covers assert themselves, and these are primarily horizontal structures.

VII. Fog

In the observations of fog, we see strong variations both between the Hel Peninsula and the neighboring coast, as well as between the individual stations (Table 36). Fog occurs on the Peninsula more rarely and irregularly. The tip of the Peninsula itself is quite unique, in that it has an average of 47 days with fog during the year. Jastarnia recorded 21 days with fog and Chałupy only 17. This wide variation in fog is undoubtedly based on local conditions, which for even such small terrain accentuates their effects. On the coast, Gdynia has the most number of days with fog, that is, 70 days per year, Rozewie has 65, and Karwia has 53. If we take into consideration the individual seasons of the year, fog is most rarely met during the summer. In addition, it may be stated that the fog intensity is variable. Jastarnia, Chałupy, and Rozewie show maximum levels in the spring, Karwia in the autumn, Gdynia in the winter, and Hel gives different values for the winter and the spring. This seemingly pronounced chaos in the annual distribution underlines to an even greater extent the local effects giving rise to these great variations.

Absolute maximums in the number of days with fog are shown at Hel and Jastarnia in March, in November for Chałupy and Karwia, in December for Rozewie, and in February for Gdynia. In general, it may be stated that fog intensity is noted in the period from October to March inclusively.

The occurrence of fog at specific times of the day, as well as the approximate times of their duration, have been compiled in terms of their percentages in the list given below:

- early morning (Ia) 27.7%

- noon (II) 8.5%
- evening (p III) 21.3%
- night (n) 27.7%
- the whole day (from I-III) 6.3%
- the whole 24-hour period 8.5%

Table 36. Mean and maximum number of days with fog in the individual months and seasons of the year (1928-1938)

Locale		Month												Yr	Spring	Summer	Autumn	Winter
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII					
Hel	mean	5	4	6	4	5	2	2	2	2	4	4	6	47	13	6	10	15
	max.	12	8	13	11	10	4	6	3	9	10	8	10	68				
Jastarnia	mean	2	2	3	2	2	1	1	1	1	2	3	2	21	7	3	6	6
	max.	6	6	11	6	8	8	3	2	5	8	8	5	51				
Chałupy	mean	1	1	3	2	2	1	0,3	0,4	0,5	1	2	2	17	7	1,7	3,5	4
	max.	7	2	8	6	6	2	1	1	3	5	9	5	33				
Gdynia	mean	8	7	8	5	5	2	3	4	5	7	9	9	70	18	9	21	24
	max.	18	22	15	11	12	5	10	11	12	14	16	20	125				
Rozewie	mean	7	4	6	6	8	4	3	2	2	5	10	8	65	20	9	17	19
	max.	16	9	15	13	18	7	6	6	6	11	16	19	102				
Karwia	mean	4	4	7	3	4	2	2	2	5	6	7	6	53	14	6	18	14
	max.	10	7	13	8	8	4	5	4	11	13	19	13	89				

Table 37. Average number of days with storms (1928-1938)

Locale	Month												Yearly
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel	.	.	0,3	0,6	2,8	2,8	3,6	3,1	1,6	0,4	.	0,1	15,4
Gdynia		.	0,1	0,6	3,1	3,5	4,8	3,4	1,4	0,4	.	.	17,2
Karwia	.		.	0,1	0,9	0,6	1,7	1,2	0,8	0,4	.	.	5,7

Fog is observed most frequently during the morning and night and after that, in the afternoon and in the evening. Fog is found at noon in only exceptional cases. Its occurrence throughout the whole day is recorded for 6.3% of the time, and throughout the whole 24-hour period, 8.5% of the time.

VIII. Storms

Both on the Peninsula, as well as on the neighboring coast, storms are relatively infrequent phenomena (Table 37). Weather with storms most frequently occurs in July and August. At Hel station in general, there were no storms observed for

the following months: January, February, and November, and in Gdynia, in addition, there were no storms observed in December, and in Karvia nonewere observed in March.

It should be noted that these storms are characterized by a relatively small number of electrical discharges. A much closer analysis of this weather element, which is very important for vegetation, would certainly yield interesting results.

ANALYSIS OF CLIMATIC CONDITIONS

We shall attempt to assemble and compare the results derived with the course of meteorological elements that have already been worked out up to the present time. We find the longest observational period in the work, Klimakunde des Deutschen Reiches [Climatology of the German Empire].

The annual courses of the mean monthly temperatures from the periods 1851-1930 and 1928-1938 are very similar to one another (Table 38). Identical values are obtained for the temperatures in the following months: January, March, and September. The greatest discrepancy towards the plus side from the mean perennial value is obtained in mid-November, and following that, in May. October and December are warmer

Table 38. Mean monthly temperatures for Hel station

Period	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1851—1930	−0,6	−0,6	1,3	5,1	9,2	14,3	17,3	17,1	14,1	9,4	4,1	0,8	7,7
1928—1938	−0,6	−1,0	1,3	4,8	10,3	14,1	17,2	17,2	14,1	9,8	5,4	1,0	7,8

as well. In our series, February turned out to be significantly colder; its mean value in the perennial series is identical with the mean value for January. The mean monthly values diverge slightly towards the minus side in the following months: April, June, and July. Differences between both series show up only in decimal fractions of a degree, giving on the average an annual deviation of only 0.1°.

There are somewhat greater deviations in the extreme temperatures. Maxima of the absolute temperatures are in general lower for the 11-year period, and the minima are higher (with the exception of September 1931). It is only in March 1938, June 1935, and August 1932 that higher maximum temperatures are noted than in the longer series.

The number of days with average daily temperatures higher than 5°C is on the average 208 days, and in our series it is 212 days. The difference is thus very small. The data shown above indicate that the period 1928-1938 was a somewhat warmer period than in comparison to the longer period.

We must remember, as well, the frosts whose periods of appearance and retreat

at the Hel station fluctuate within the limits of 10 days, in comparison to the periods developed by Z. Pieślak [17].

The specific local conditions of the area under study suggest the necessity of comparing wind temperatures with sea water temperatures. We shall present this kind of material only for the temperature of the water surface for the pertinent observational period, that is, from 1927 to 1933.

The data have been excerpted from the work by K. Demel [3] (for the period 1927-1933), as well as from the work, Monatskarten der Oberflächentemperatur für die Nord- und Ostsee und die angrenzenden Gewässer [Monthly Charts for the Surface Temperature of the North and East Seas and for the Adjacent Waters], by G. Böhnecke and G. Dietrich, for the period 1934-1938.

In this compilation of mean monthly temperatures for both environments (Table 39), we note the fact that it is only in three months (that is, in April, May, and June) that the mean air temperature is higher than the mean temperature of the sea surface water. This is certainly connected to the prevailing flow of atmospheric masses out of the northeast during these months; this is confirmed in the prevailing wind directions (see Table 40). In April, it is the easterly flow direction that

Table 39. Mean monthly temperatures for the sea surface water and mean air temperatures for Hel station (1928-1938)

Temperature	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Sea	2,0	1,1	1,6	4,2	8,6	13,0	17,6	18,3	15,9	11,8	7,6	3,8	8,8
Air	—0,6	—1,0	1,3	4,8	10,3	14,1	17,2	17,2	14,1	9,8	5,1	1,0	7,8

dominates, and from this we see that the greatest portion of winds is the easterly, southeasterly, and northeasterly ones. It is only the northeasterly winds that drive the cold waters of the North Baltic into this southern region. This process checks water temperature increases, despite the constant increase in insolation. In May, it is the northeasterly, northerly, as well as easterly winds that predominate. The flow of air masses out of the northeast favors an increase in the coldness of the water, and the strong insolation that takes place with clear air masses favors strong air heating. In June, the water temperature increases significantly and decreases

Table 40. Proportions of wind directions for Hel station during the year 1881-1918 (a) and 1928-1938 (b)

Season of the year		N	NE	E	SE	S	SW	W	NW	Calms
Spring	a	12,7	13,3	15,7	12,1	14,0	5,9	7,9	12,4	3,3
	b	13,1	13,9	14,5	12,7	9,7	7,6	12,2	12,5	4,8
Summer	a	15,2	14,3	9,5	7,5	10,7	7,6	11,0	20,4	3,7
	b	12,3	10,1	9,9	7,1	8,9	8,9	19,9	18,6	4,6
Autumn	a	8,9	7,1	8,9	12,2	24,5	12,8	10,9	13,6	2,0
	b	6,9	4,7	6,7	12,1	21,1	16,6	16,8	12,3	2,3
Winter	a	7,7	4,2	6,3	12,6	27,2	14,1	12,3	14,9	1,2
	b	5,9	4,9	8,2	16,3	21,9	14,6	15,7	9,8	4,9
Year	a	10,8	11,3	9,7	11,0	19,5	9,9	10,4	15,3	2,5
	b	9,5	8,1	9,9	12,1	15,2	11,9	16,2	13,3	4,0

the difference with respect to air temperature. The quite high portion of northerly and northeasterly winds causes a mixing of the surface waters of the South Baltic with the cold waters flowing in from the north.

In the remaining months, the water everywhere has higher mean temperatures than the air temperatures. At the same time, the greatest discrepancy occurs during au- /2
tumn and winter, that is, from 2° to 3°. In March and July, the differences in mean temperatures of both these environments are the least.

Comparing the proportions of wind directions across the scale of a year from the years 1881-1918 (Klimakunde) and 1928-1938, we see (Table 40) significant shifts in the predominating directions. In our series, westerly winds are the prevailing ones, but their proportion is less than the proportion of prevailing southerly winds in the series for the longer period. Indeed, southerly winds were much more frequent as well in the years 1928-1938, but they are in a different place, just as the northeasterly winds in the longer period. The northeasterly winds are noted in the longer series to be the third most frequent, but in our observational period, they are the least attested.

During the autumn and winter, there is agreement between the dominating winds, that is, the southerly winds, as well as in the least attested, that is, the northeasterly winds.

On the other hand, during the spring and summer, there is a certain shift,

namely the following: during the spring, northeasterly winds prevail, southerly winds have a high proportion, followed by the easterly winds. In the 11-year period, it is the easterly winds that prevail with high frequencies for the northerly and northeasterly winds; the least attested in both series are the southwesterly winds; in addition, during the summer the most frequent winds out of the northwest shift to the westerly direction in our series; and it is the southeasterly winds that have the smallest proportion.

We have put together a compilation of percentage proportions of the winds divided into individual groups depending on their velocities, as recorded for Hel station by L. Bartnicki [1], for the shore of the southern Baltic by St. Kończak [10], and as recorded in our work here. Because of the differences in the number of groups distinguished by these authors, we have cited the data according to Kończak's breakdown whenever it was the shortest. Accordingly, the percentage proportion of the individual groups is the following:

Winds	L. Bartnicki %	St. Kończak %	The period 1928-1938 %
Very weak and weak	50.0	50.0	60.1
Moderate	27.8	39.0	33.4
Strong and very strong	24.1	11.0	6.8

We have included the calms recorded by L. Bartnicki at 1.9% in the first group, that is, the group of weak and very weak winds.

The most frequent are the weak and very weak winds -- 50% and greater. The proportion of moderate winds varies from author to author in the range 28-39%. The greatest differences are found, however, in the strong and very strong winds; in both the longer series, there contained within the range 11-24%, and in the period 1928-1938 they are the smallest.

The overall amount of annual precipitation in Klimakunde is 528 mm, i.e., it is less than the mean amount for the 1928-1938 period by 23 mm. The differences

in the annual course of precipitation are insignificant, being either plus or minus. The greatest difference occurs in November; in this month, the monthly amount is 21 mm greater than the amount for the longer period. This is almost the entire value of the difference in the overall annual amounts for both series.

Table 41. Precipitation highs for Hel station (in mm)

Period	Month												Year
Differences													

The average monthly relative humidities are compiled from the data in Klimakunde as well as from St. Kończak's work. It turns out that it is only in April that the mean values are the same. From May to November inclusively, the 1928-1938 series shows greater humidities, and in January, February, March, and December, smaller ones. The differences between the individual series for the mean annual values vary between 1 and 2%.

Table 42. Mean monthly relative humidities according to data from (a) Klimakunde, (b) St. Kończak, and (c) from the 1928-1938 period

Designation	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
a)	88	86	84	81	78	78	79	80	80	82	85	88	82
b)	89	87	85	81	79	78	79	79	80	82	85	88	83
c)	87	83	84	81	81	80	83	84	83	85	87	87	84

We may compare the amount of cloud cover with the data given in Klimakunde as well as in Kończak's work. The differences between the individual series are minimal, varying within the range of decimal portions of the scale of cloud cover; however, in December the mean value has the same value for all the series. In the mean annual values, it is only the amount of cloud cover given by Kończak that deviates from the other two series by 0.1°.

As regards storms, we only have data from the Klimakunde. The compilation of the long-term series together with our observational series shows very small discrepancies. On the scale of whole years, the difference amounts to only three days with storms. Storms occur most frequently in July and August. They never occur in

Table 43. Mean monthly values for the cloud cover from (a) Klimakunde (b) St. Kończak, and (c) for the period 1928-1938

Designation	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
a)	7,6	7,3	6,8	5,9	5,2	5,3	5,5	5,9	5,6	6,9	7,8	8,3	6,5
b)	7,7	7,5	7,0	6,2	5,6	5,5	5,7	5,7	5,8	6,9	7,9	8,3	6,8
c)	7,7	7,6	6,3	6,2	5,4	5,1	5,7	5,6	5,5	6,8	7,4	8,3	6,5

Table 44. Mean number of days with storms at Hel station

Period	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
1891—1919		0,0	0,2	1,0	2,7	3,7	4,8	4,1	1,3	0,4	.	0,1	18,3
1928—1938			0,3	0,8	2,8	2,8	3,6	3,1	1,6	0,4	.	0,1	15,5

Table 45. Mean values of insolation (sunshine) (in hours) 1932-1937

Locale	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel	1,6	2,0	3,9	5,8	8,3	9,7	8,8	7,7	5,7	3,4	2,1	1,2	5,0
Gdynia	1,8	2,4	4,2	6,3	8,3	10,0	9,0	7,9	6,7	4,0	2,2	1,1	5,3
Warsaw	1,7	2,2	3,7	5,6	7,8	8,5	7,5	5,8	5,8	3,4	1,7	1,3	4,7

January and October, and in our series as well, they never occur in February. Storms in December and February are very rare occurrences, but nevertheless there exists a possibility for their occurrence.

When we discuss the course of individual meteorological elements for the sector of the coast under discussion here, it is necessary to remember the amount of sunshine (insolation) given in the data cited here by us from the work by W . Gorczyński [6] according to heliographic data in Gdynia, as well as on the Hel Peninsula. Data for Warsaw are also included for purposes of comparison. In comparison to Central Poland, the coast has more sunshine. Gdynia is most unique with respect to this. The insolation on the Hel Peninsula has a clear preponderance in comparison with Warsaw. With regard to Gdynia, there is a significant decrease in its hours of sunlight, especially in September and October, as well as from mid-winter to pre-spring inclusively.

CONCLUSIONS

From the analysis undertaken here of the individual meteorological elements, the following conclusions are suggested: although they are certainly far from a synthetic understanding of the Hel Peninsula climate, still they give in outline the climatic conditions that prevail there. The basic character of the region that was studied here is the great variability in weather states, both from day to day, as well as from month to month and from year to year. This phenomenon is the consequence of the location of the Peninsula on the path of the tracks taken by the Atlantic families of lows. Certainly, breezes* as well should be stressed among the short-wave variations, for it is they that cause certain variations in local weather conditions. /2

The dispersion in variability between individual months is, however, not great; and as a result of this, the longest seasons are the transitional periods between summer, which is the shortest season of the year, and winter. The summer is relatively cold, and the winter with regard to thermal conditions has a mild course. The autumn period of the "Indian summer" is the nicest season of the year. However, the late autumn begins the cycle of stormy weather which lasts throughout the winter and pre-spring. If we add in addition that throughout almost the whole year the air is very humid, that throughout the whole year there exists the possibility of fog, and that in all the months strong winds were recorded, this will be more or less the basic general feature of the climate for the region studied here.

It is necessary to note that a certain kind of conservatism in the Baltic causes the delay of almost all the seasons of the year.

We shall go now to the particular characteristics of the individual seasons of the year.

Spring

Spring is the period for the occurrence of varied weather complexes. The "conservative" influence of the Baltic, which establishes the beginning of spring

*The problem of the breezes over our coastline has received no treatment up to the present time.

to be on the average on the 23rd of April, also sets off the pre-spring season, marking it to be on the average from the 13th of March.

The pre-spring season is characterized by stormy weather. Both polar masses, as well as Arctic masses, are characterized by strong storm winds (with velocities of 15 m/sec and greater). In addition, there are tropical air masses, but they are less powerful. Storm weather is always accompanied by fleeting precipitation of light intensity in the form of rain, snow, or rain with snow.

During the spring, particularly in the May and June period, a great drop in wind velocity is characteristic (on the scale of the whole year, these winds are the weakest), as well as increased sunshine, giving as a result the largest number of days with sun. The cold Arctic air masses flowing in in May, thanks to the clearness of the air (very good visibility), yield days with beautiful blue skies with dwindling white strips of clouds. The proportion of polar masses is great, with tropical air masses occuring only sporadically. Precipitation increases significantly in comparison with precipitation in the month of April, but it is in general in the form of storms.

All of the weather complexes, thus, as may be seen from what has been said above, consist in a significant increase in air temperature, causing in May the so-called "skok majowy" ["the May jump"]. On the other hand, reoccurrences of cold air, often bringing with them frost, even in June (1 June 1930 and 2 June 1932), have an unpleasant effect.

In June, humid polar masses predominate (out of the west and northwest), significantly refreshing the area under consideration here with precipitation. High insolation, the lowest air humidity during the year, as well as the very weak winds are basic characteristics of the second half of the spring.

Summer

The summer is short and has a great deal of precipitation. The maximum amount of precipitation across the scale of the whole year occurs in fact in July. The high humidity of the polar masses, which are very frequent during this period, as well as the intensive evaporation of the sea surface, forms favorable conditions for the

occurrence of precipitation. Summer precipitation has primarily the character of storms, and at times there may even be torrential downpours. The masses of Arctic origin flowing in suddenly out of the north bring with them an aggravating cold. The strong winds met here are only sporadic.

Autumn

The early autumn (September and the first days of October) is the most mild along the whole shore; storms are a rarity. Rains last for only a short time, and the proportion of all air masses is uniform. The weather complexes do not distinguish themselves by any special dynamic activity. From foggy mornings, there may arise sun-filled days, ending with relatively warm and quiet evenings.

The winds begin to pick up in strength in October, and it is at that time that the stormy period begins. The prevalence of polar air masses becomes the rule, as well as the relatively frequent appearance of tropical air masses. Both of these yield significant levels of precipitation of a continuous sort. The high level of cloud cover, the strong winds, and the continuous rainfall contribute to the formation of a weather type called "szaruga jesienna" ["autumn bad weather, squalls"].

From the 15th to the 19th of November, a strong drop in temperature is noted, which is the correlate to the "May jump," in the opposite sense. At this time, that is, on the 17th of November, we have the beginning of the pre-autumn, characterized by sudden changes in cold waves, which are accompanied by frost and snow precipitation, as well as by heat waves accompanied by thaws. The overcast days with long-lasting or weak precipitation, as well as the frequent storm winds are characteristic features of this period.

Winter

The winter is a short period, but the weather is in great dynamic activity. Sudden changes in the weather, frequent storms, fog, and high levels of cloud covering, as well as weak precipitation are frequent phenomena in the winter. The snow cover does not last long, except during an exceptionally sharp winter. The sudden inflow of moist and warm polar-sea masses wipes away the snow covering, often completely. Sharp continental-type winters occur only rarely, and most often we have

winters of the oceanic type.

The Influence of the Baltic

The Baltic, as it is a natural heat condenser, exerts a direct influence on the course of meteorological phenomena in the lower levels of the atmosphere. The /2
process of mutual heat exchange between the air and the sea water yields, as a result, long transitional periods between the summer and the winter, a significantly mild course for the winter as regards the thermal aspect, and the summer is usually cooled down with very high air humidity lasting throughout the whole year. The influence of the Baltic, however, is only very mild inland. Even in Lębork which is very near, or in Kościerzyna, not to speak of Malbork or even Bydgoszcz lying further to the south, we have completely different thermal relationships (Table 46). Temperature highs, which have been used up to the present time to determine whether a climate is oceanic or continental, are lower in Hel, rising very quickly as we proceed inland. The rain relationships, as well as wind, change almost with every increase. The extent of the direct influence of the Baltic disappears, therefore, rather quickly both across the horizontal and with increases in the elevation of the terrain.

Table 46. Mean January, July, and yearly temperatures together with the annual amplitude (1881-1930)

Locale	Mean temperature			Amplitude
	January	July	Year	
Hel (1928-1938)	-1.0*	17.2	7.8	18.2
(1881-1930)	-0.6	17.2	7.8	17.8
Lębork	-1.5	16.9	7.2	18.1
Kościerzyna	-3.2	16.7	6.5	19.9
Malbork	-2.5	17.6	7.3	20.1
Bydgoszcz	-2.1	18.4	7.8	20.5

*The mean monthly temperature for February, when this month appears in our series, is the coldest.

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TABULAR COMPILATIONS

Mean monthly and annual temperatures in °C for the stations: /2
Hel, Jastarnia, Chałupy, Gdynia, Puck-Airfield, Rozewie, Karwia (1928-1938)

Summer	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel													
1928	−0,3	−0,2	−0,1	4,4	8,1	11,8	16,2	15,5	13,2	9,6	7,6	−0,1	7,1
1929	−3,5	−9,2	−1,5	1,2	9,1	11,7	15,8	16,4	14,5	10,8	5,9	3,6	6,3
1930	2,0	6,1	2,0	6,2	10,2	15,8	17,0	16,5	13,2	10,2	6 0	0,5	8,3
1931	0,9	−2,4	−1,3	3,0	13,0	13,4	16,3	15,7	14,3	8,9	3,6	1,6	6,9
1932	1,5	1,5	1,1	5,0	11,0	12,9	19,2	18,3	14,6	9,2	5,0	2,3	8,0
1933	−2,5	−0,9	1,5	4,0	8,4	14,0	17,7	16,9	13,6	9,4	3,1	−1,9	7,0
1934	0,2	2,3	3,2	6,9	12,2	14,8	17,0	17,8	16,3	11,4	6 8	1,8	9,2
1935	2,0	1,1	1,0	5,2	7,8	15,7	16,8	16,6	14,3	10,2	4,7	1,5	7,3
1936	2,1	−1,2	2,3	5,4	10,9	15,1	18,9	17,1	13,4	7,1	4,6	2,9	8,2
1937	−3,1	0,2	1,7	6,2	12,7	15,5	17,2	18,6	15,5	10,6	4,5	−0,4	8,2
1938	0,5	1,3	3,2	4,7	9,7	14,8	17,3	19,2	14,8	10,8	7 0	−1,8	8,6
Mean long-term	−0,6	−1,0	1,3	4,8	10,3	14,1	17,2	17,2	14,1	9,8	5,4	1,0	7,8
Jastarnia													
1928	−0,5	0,1	0,3	4,0	7,6	11,3	16,1	15,4	13,7	9,2	7,3	2,8	7,4
1929	−3,1	−8,3	−0,6	1,6	9,0	12,0	15,4	16,6	14,5	10,7	5,7	3,3	6,3
1930	1,9	0,1	2,2	6,0	9,3	15,6	16,5	16,7	13,6	10,3	5,6	0,2	8,3
1931	−0,3	−2,5	−1,6	3,2	12,4	13,4	16,6	15,9	14,5	8,1	3,6	1,4	6,8
1932	1,4	−1,3	−1,1	5,1	10,4	12,7	18,9	18,8	14,8	9,2	5,0	2,4	8,0
1933	−3,4	−0,8	2,2	4,2	8,4	13,5	17,6	17,0	14,0	9,7	3 3	−1,0	7,1
1934	0,0	2,2	3,4	7,1	11,7	14,6	16,8	18,0	16,3	11,3	6,8	2,0	9,2
1935	1,4	1,1	1,6	5,6	7,8	14,9	16,5	16,9	14,7	10,1	4,6	1,4	7,9
1936	1,8	−1,6	2,1	5,1	9,8	14,5	18,7	17,2	13,6	7,3	4,6	2,8	8,0
1937	−3,3	−0,2	1,0	6,3	12,1	15,4	17,4	19,0	15,7	10,8	4,3	0,4	8,2
1938	0,2	1,5	3,6	4,9	9,7	14,8	17,3	19,5	15,2	10,8	7,2	1,6	8,8
Mean long-term	0,2	0,9	1,5	4,9	9,9	14,0	17,1	17,4	14,3	9,8	5,3	1,2	7,8
Chałupy													
1928	0,6	0,3	0,9	4,5	7,9	12,0	16,6	15,7	13,8	9,1	7,2	0,1	7,3
1929	−3,0	−8,9	−0,5	2,1	9,2	12,8	16,8	17,2	14,7	10,5	5,4	3,2	6,5
1930	1,6	0,1	2,2	6,0	10,2	15,8	17,0	16,8	13,6	10,0	5,6	0,1	8,3
1931	−1,5	−2,6	−1,6	3,1	12,1	13,6	16,8	16,0	14,6	8,0	3 3	1,6	6,8
1932	1,5	−1,1	−1,0	5,4	10,3	13,1	19,2	18,8	14,7	8,8	4,8	2,3	8,1
1933	−3,3	−0,8	2,1	4,3	8,5	13,3	18,0	17,1	14,1	9,6	3,4	1,0	7,2
1934	0,1	2,3	3,3	7,2	11,7	15,0	17,0	18,1	16,1	11,1	6,6	2,0	9,2
1935	−2,1	1,2	1,2	5,9	8,3	16,2	17,2	17,1	14,2	10,2	4,2	1,2	7,9
1936	1,7	−1,6	2,4	5,1	9,5	15,0	19,1	17,4	13,8	7,1	4,3	2,4	8,0
1937	−3,4	−0,2	1,0	6,0	12,3	15,1	17,8	19,6	15,8	10,6	4,3	−0,5	8,2
1938	0,1	1,0	3,2	5,1	10,0	15,3	17,6	19,0	15,4	10,8	7 1	1,7	8,3
Mean long-term	0,4	0,9	1,5	5,0	10,0	14,4	17,6	17,5	14,3	9,9	5,1	0,9	7,8

Summer	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gdynia													
1928	-0,1	0,4	0,5	5,0	8,9	13,1	16,2	15,3	12,4	8,9	7,1	-0,3	7,2
1929	4,7	-10,2	0,5	1,1	10,5	12,5	16,5	16,5	13,9	10,3	5,0	3,0	6,2
1930	2,0	0,1	2,3	6,6	11,1	16,4	16,4	16,4	12,6	9,6	5,0	0,6	8,2
1931	-0,7	-2,7	-1,6	3,6	14,2	14,3	17,0	15,7	11,3	7,6	3,2	1,4	7,0
1932	1,7	-1,6	-1,2	6,4	12,0	17,4	19,3	18,5	14,4	8,8	4,6	2,4	8,2
1933	-4,1	-0,8	2,8	4,5	9,6	14,3	18,0	16,6	13 1	9,2	2,6	-1,7	7,0
1934	0,1	2,4	3,5	7,8	12,3	15,1	16,9	17,3	15,3	10,8	6,1	1,2	9,2
1935	-2,3	1,4	2,1	6,3	8,6	16,8	16,2	17,0	14,0	9,9	3,9	0,6	8,0
1936	1,0	-2,1	2,4	5,4	11,4	15,7	19,0	16,9	13,0	7,0	4,3	2,6	8,1
1937	-3,8	0,2	1,1	6,7	13,7	16,0	17,5	18,6	15,1	10,0	3,9	-0,8	8,3
1938	0,6	2,0	6,7	5,2	10,5	15,7	17,8	19,6	14,5	10,7	7,0	-2,3	9,0
Mean long-term	-0,9	-1,0	1,8	5,3	11,2	14,8	17,5	17,2	13 7	9,3	4,8	0,5	7,7 7,8
Puck-Airfield													
1928	-0,3	0,2	0,2	4,6	8,0	11,7	15,8	14,7	12,0	8,5	6,9	-0,6	6,8
1929	-4,4	-9,9	-0,3	1,1	9,9	11,8	15,3	15,2	13,6	9,7	4,8	3,0	5,8
1930	1,8	0,0	2,1	6,3	10,4	15,4	16,0	15,7	12 6	9,4	5,0	-0,4	7,8
1931	-1,0	-2,8	-2,3	3,2	13,2	13,3	16,4	15,1	10,9	7,3	3,0	1,0	6,4
1932	1,2	-1,8	-1,8	5,8	11,7	12,9	18,6	17,8	13,8	8,0	4,3	2,0	7,7
1933	-3,8	-1,2	2,4	3,8	8,5	14,2	17,4	15,6	12,7	8,8	2,4	-1,8	6,6
1934	-0,1	2,0	3,4	7,2	11,6	14,4	16,4	17,1	14,8	10,2	5,5	1,5	8,7
1935	-2,7	1,2	1,6	5,8	7,9	16,0	16,2	16,2	13 3	9,3	3,8	0,8	7,4
1936	1,4	-2,2	2,0	5,1	10,5	15,0	18,3	16,4	12,2	6,6	4,1	2,2	7,6
1937	-3,8	-0,2	1,0	6,7	13,0	15,6	16,8	18,1	14,5	9,0	3,5	-0,9	7,8
1938	0,2	1,4	5,7	4,8	10,0	14,7	17,2	19,0	13,5	10,4	6,5	-2,2	8,4
Mean long-term	-1,0	-1,2	1,3	4,9	10,4	14,1	16,8	16,4	13,1	8,9	4,5	0,4	7,4
Rozewie													
1928	-0,4	0,3	0,5	4,1	7,0	11,2	15,4	14,8	12,4	9,1	6,8	-0,5	6,7
1929	-4,1	-8,5	-0,3	1,3	8,4	10,8	15,5	15,9	13,4	10,0	4,8	3,0	5,8
1930	1,7	0,2	1,9	5,2	9,3	14,3	15,8	15,7	12,6	9,6	5,1	-0,3	7,8
1931	-0,7	-2,5	-1,7	2,8	11,5	12,4	15,6	15,0	11,0	7,4	3,1	1,4	6,3
1932	1,4	-1,4	-1,5	5,5	10,3	12,2	18,3	18,0	14,0	8,2	4,2	2,2	7,6
1933	-3,7	-1,1	2,4	3,8	7,8	13,2	17,1	16,2	13,4	8,9	2,6	-1,2	6,6
1934	-0,1	1,9	3,0	6,3	11,5	13,9	16,1	17,2	15,5	10,6	6,2	1,6	8,7
1935	-2,4	1,3	1,6	5,6	7,5	15,7	16,3	16,4	13,5	9,3	3,6	0,6	7,4
1936	1,4	-2,0	2,0	4,6	9,1	14,4	17,8	16,4	13,0	6,4	4,4	2,2	7,5
1937	-3,7	-0,2	0,7	5,4	12,0	14,8	16,7	18,2	14,6	9,8	3,8	-0,8	7,6
1938	-0,1	1,5	5,3	4,1	9,3	14,2	16,7	18,4	14,2	10,1	6,7	-2,0	8,2
Mean long-term	-1,0	-1,0	1,3	4,5	9,4	13,4	16,5	16,6	13,4	9,0	4,7	0,8	7,3
Karwia													
1928	-0,2	0,4	0,7	4,5	7,2	11,5	15,4	15,1	12,4	9,0	7,0	-0,3	6,9
1929	-4,3	-8,8	0,1	1,4	8,8	11,5	15,0	15,8	14 0	10,0	4,9	3,2	6,0
1930	2,0	0,4	2,2	6,1	10,1	15,3	16,4	16,2	12,9	9,8	5,4	-0,2	8,0
1931	-0,4	-2,2	-1,5	3,4	12,4	13,1	16,8	15,4	11,3	7,8	3,3	1,6	6,7
1932	1,6	-1,2	-1,2	5,6	10,7	12,8	18,8	18,5	14,4	8,5	4,6	2,4	8,0
1933	-3,6	-1,0	2,2	4,2	8,4	13,7	17,5	16,7	13,8	9,0	2,8	-1,5	6,8
1934	0,0	2,3	3,4	7,2	12,2	14,6	16,9	17,5	15,3	10,8	6,2	1,7	9,0
1935	-2,2	1,6	1,7	5,8	7,9	16,1	16,7	16,7	13 7	9,6	3,7	0,7	7,7
1936	1,5	-1,8	2,2	5,0	9,4	15,1	18,8	17,0	13,3	7,0	4,2	2,4	7,8
1937	-3,6	0,3	1,1	6,8	12,4	15,7	17,3	18,3	15,0	9,5	3,8	-0,5	8,0
1938	1,8	1,5	5,4	4,9	9,8	14,8	17,6	18,2	14,4	10,6	6,7	-2,0	8,6
Mean long-term	-0,7	-0,8	1,5	5,0	9,9	14,0	17,0	16,9	13,7	9,2	4,8	0,7	7,8

Number of days with minimum temperatures lower than 0°C for the stations: Hel, Gdynia, Karwia 1929-1938 /3

Summer	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1929	31	28	25	26	2	.			.	.		8	120
1930	11	22	19	6	1	1			.	.	5	18	83
1931	27	25	28	15	.	.			1	2	10	16	124
1932	29	26	29	11	2	.				1	5	12	106
1933	25	21	19	9	1	.			.	1	9	27	112
1934	20	12	6	6		.			.	.	.	12	56
1935	27	15	23	8	8	.			.		6	15	102
1936	13	24	21	9	1	.			.	1	9	10	88
1937	21	21	20	2	1	.			.	.	7	26	98
1938	16	15	6	9	2	.			.	.	3	18	69
Mean long-term	21.1	20.9	19.6	10.1	1.8	0.1	.	.	0.1	0.5	5.4	16.2	95.8
Gdynia													
1929	31	28	24	24	1	.			.		4	12	121
1930	16	23	16	3	1	.			.	.	6	21	85
1931	25	26	28	12	.	.			.	4	11	17	123
1932	17	26	23	5	.	.			.	.	6	16	98
1933	26	20	17	9	1	.			.	.	8	27	108
1934	21	11	5	4	.	.			.	.	.	15	56
1935	27	14	20	5	3	.			.	.	9	20	98
1936	14	24	14	5	.	.			.	.	9	11	77
1937	21	17	15	.	.	.			.	.	5	24	82
1938	16	16	5	7	.	.			.	.	.	18	62
Mean long-term	21.4	20.5	17.2	7.4	0.6	.	.	.	.	0.4	5.8	18.1	91.4
Karwia													
1929	31	28	29	26	3	.			.	.	7	11	135
1930	22	24	23	4	1	1			.	.	6	23	104
1931	29	25	30	13	1				1	6	12	16	134
1932	19	28	29	9	1	.			.	.	7	17	110
1933	28	21	19	13	2					1	12	27	123
1934	22	12	12	6	.					.	3	13	68
1935	28	15	20	11	3	.				.	12	20	109
1936	14	21	16	8		.				1	9	17	86
1937	22	21	20	1	.	.			.	.	11	27	102
1938	17	19	6	9	3	.				.	3	20	77
Mean long-term	23.2	21.7	20.6	9.9	1.4	0.1	.	.	0.1	0.8	8.2	19.3	105.3

Percentage proportion of specific wind directions for the stations:
Hel, Jastarnia, Chałupy, Gdynia, Puck, Rozewie, Karwia 1928-1938

/3

Month	Direction								Calms
	N	NE	E	SE	S	SW	W	NW	
Hel									
January	5,7	3,8	6,7	19,4	21,6	13,6	16,0	5,7	5,6
February	7,8	6,5	9,5	15,1	16,0	8,3	17,7	12,5	5,6
March	9,6	6,5	11,7	14,5	12,0	11,2	17,2	13,0	4,0
April	12,0	11,1	13,9	11,6	9,1	6,7	10,1	19,5	6,0
May	17,8	13,4	16,1	8,8	7,5	4,8	9,8	13,6	7,8
June	13,0	11,7	11,1	7,1	8,2	9,0	19,1	11,4	9,1
July	11,7	7,7	9,1	6,6	6,9	19,7	21,9	20,2	5,2
August	11,6	11,5	9,5	8,2	10,2	7,1	13,3	18,0	5,6
September	11,8	7,8	7,5	10,9	16,0	11,3	16,2	13,8	5,9
October	6,2	3,6	5,1	9,7	21,1	19,9	20,6	11,2	2,6
November	2,9	2,9	7,2	14,9	25,6	18,0	13,5	11,8	1,4
December	3,8	4,0	5,7	17,9	25,6	15,2	12,8	9,1	2,6
Year	9,3	8,1	9,9	12,1	15,2	11,9	16,2	13,1	4,0
Jastarnia									
January	4,5	3,7	4,7	6,7	21,1	18,8	17,2	7,0	8,3
February	8,8	7,2	9,6	10,2	14,7	11,4	17,8	9,7	10,6
March	9,2	8,2	11,1	8,3	15,7	8,2	16,7	10,7	11,6
April	11,3	13,1	17,0	10,8	10,6	6,5	11,0	7,8	11,1
May	16,1	16,0	16,3	7,0	7,0	3,3	9,3	9,2	11,8
June	12,5	10,2	10,9	3,9	9,5	4,9	22,7	12,2	13,2
July	12,6	5,6	7,1	2,9	7,1	9,4	21,0	13,2	17,0
August	11,7	10,1	10,6	4,5	8,3	9,1	18,5	10,9	16,3
September	11,8	8,3	7,9	6,3	12,3	10,9	17,8	8,3	16,3
October	7,1	4,2	5,1	6,5	16,8	19,0	23,2	6,7	9,4
November	5,3	2,8	5,4	12,7	23,8	19,4	14,9	8,1	7,6
December	4,7	3,9	9,1	14,7	21,7	14,0	16,1	6,1	5,7
Year	9,7	7,6	9,6	8,0	14,7	11,6	17,4	9,2	12,0
Chałupy									
January	4,4	3,7	5,4	7,4	21,1	16,7	14,1	6,9	4,3
February	9,1	8,2	10,8	10,1	16,7	14,1	16,5	10,4	4,1
March	11,1	10,1	11,4	8,5	15,1	12,0	15,6	12,8	3,5
April	13,3	13,1	19,1	8,5	9,2	5,1	10,1	9,6	3,2
May	21,4	15,7	15,8	5,9	7,2	6,3	8,7	11,2	6,8
June	14,4	11,1	10,1	4,4	6,1	9,5	14,1	11,1	9,5
July	17,5	8,9	8,1	3,1	5,0	11,1	17,3	15,1	4,8
August	16,3	13,1	9,0	3,1	6,7	12,3	15,8	13,2	1,7
September	12,4	9,2	7,2	6,4	14,1	13,9	17,2	10,1	4,0
October	8,6	6,0	6,6	7,3	19,6	17,1	15,3	7,1	1,9
November	5,2	3,1	4,9	11,7	26,1	21,1	10,3	3,2	1,5
December	5,0	3,1	9,1	13,0	27,1	21,5	10,6	6,5	1,9
Year	11,7	9,1	10,2	7,2	15,2	13,9	13,9	10,1	4,6

Month	Direction								Year
	N	NE	E	SE	S	SW	W	NW	
Gdynia									
January	2,3	2,1	3,3	13,2	25,0	19,0	20,5	10,7	3,9
February	5,9	4,8	7,5	15,9	17,3	12,0	19,5	17,5	5,0
March	7,1	6,6	7,8	13,6	11,8	11,2	17,9	16,0	7,8
April	8,3	10,1	13,1	15,9	7,8	8,1	13,7	14,9	8,1
May	12,6	10,9	10,8	12,6	7,3	5,9	11,4	17,9	10,6
June	8,5	8,0	7,9	10,1	7,0	9,5	22,1	18,6	5,9
July	6,5	5,5	6,6	3,4	6,6	10,6	24,1	22,6	0,1
August	7,4	8,6	6,8	7,6	8,5	10,3	21,5	19,4	7,9
September	6,8	6,0	5,8	10,4	13,1	14,1	22,5	15,8	5,5
October	4,3	2,9	3,8	9,2	17,3	22,7	23,8	12,4	3,6
November	2,1	1,7	4,0	17,4	21,5	19,8	19,9	9,8	3,8
December	2,3	3,0	5,9	17,2	24,4	14,3	17,4	11,0	4,5
Year	6,3	5,9	7,1	12,6	13,5	13,1	19,7	15,5	6,3
Puck									
January	1,7	3,4	6,4	17,5	14,7	23,9	19,8	4,3	8,3
February	5,1	5,4	11,6	15,4	6,8	15,2	21,6	11,1	7,8
March	6,1	5,7	13,5	15,0	5,0	12,6	21,9	10,1	10,1
April	7,1	12,1	19,6	11,3	5,5	9,7	14,5	9,3	10,9
May	9,0	16,0	15,9	9,0	3,3	6,5	15,1	12,6	12,6
June	7,4	9,6	11,4	8,0	3,4	12,0	27,4	10,7	10,1
July	5,3	5,6	8,5	6,3	3,6	15,5	29,3	14,1	11,8
August	6,3	10,6	9,3	6,9	4,1	14,3	22,2	10,4	15,9
September	7,5	6,8	9,1	9,8	6,6	17,6	19,3	8,2	15,1
October	3,8	2,9	4,5	11,7	12,7	27,7	19,2	7,8	9,7
November	2,0	2,0	5,7	21,6	15,4	24,4	14,5	6,1	8,3
December	2,2	3,9	9,1	20,9	15,6	20,0	14,5	5,9	7,9
Year	5,3	7,0	10,4	12,8	8,1	16,8	19,9	9,2	10,7
Rozewie									
January	3,5	4,3	3,8	20,4	14,1	26,5	15,6	4,8	7,0
February	5,7	5,2	6,5	16,0	10,5	20,4	17,8	9,9	7,4
March	5,7	7,0	6,1	19,7	5,9	18,0	20,9	7,4	9,3
April	5,8	10,1	12,5	18,0	5,6	12,9	13,7	8,3	13,1
May	4,7	11,9	11,8	14,5	4,7	10,0	17,9	10,0	14,5
June	3,6	4,5	7,1	10,6	4,9	16,2	28,3	10,3	14,5
July	2,4	2,4	3,5	8,7	3,9	19,6	32,8	12,5	14,4
August	4,7	4,5	4,7	8,0	4,8	16,9	24,3	13,9	18,2
September	5,5	3,8	3,1	14,8	7,3	21,5	19,2	9,5	15,3
October	3,9	3,0	3,5	13,9	10,3	30,4	18,4	9,2	6,9
November	3,0	2,0	3,4	20,5	17,3	27,2	11,4	9,2	6,0
December	3,6	4,8	5,8	23,3	15,9	23,5	11,6	7,1	4,6
Year	4,3	5,3	6,0	15,7	8,8	20,3	19,3	9,3	11,0
Karwia									
January	4,3	3,8	5,7	18,5	14,1	26,4	15,5	7,2	4,5
February	8,0	8,4	10,5	15,4	7,9	17,4	16,9	12,0	3,5
March	7,4	8,4	11,1	15,0	5,3	15,2	18,6	13,1	5,9
April	11,0	14,4	13,5	13,4	5,7	9,5	11,6	13,1	7,6
May	11,0	18,0	10,0	7,9	4,4	6,3	14,2	14,6	13,6
June	8,2	9,3	6,2	9,1	3,6	13,1	26,4	13,7	10,4
July	6,7	5,1	4,0	6,8	4,2	16,3	26,7	17,1	12,5
August	10,0	9,7	6,5	5,9	5,0	13,4	20,7	17,9	10,9
September	10,1	9,1	5,9	11,5	6,8	17,3	14,7	13,9	11,1
October	7,3	6,2	5,4	9,9	10,8	28,6	18,5	9,4	6,8
November	5,1	7,1	5,8	20,4	14,0	21,8	17,3	11,0	8,0
December	4,2	5,6	6,3	23,1	16,2	21,7	10,5	7,3	4,4
Year	7,3	8,1	7,6	13,0	8,2	17,4	17,1	12,1	8,3

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Mean monthly and annual wind velocities in m/sec for the stations:
Hel, Jastarnia, Chałupy, Puck, Rozewie, Karwia 1928-1938

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1928	4,7	4,0	3,7	3,6	3,2	4,0	3,9	3,8	2,5	3,4	4,4	4,8	3,8
1929	5,5	4,1	4,0	4,3	3,5	3,2	3,6	2,8	5,1	4,7	4,1	6,6	4,3
1930	5,7	5,5	5,5	5,0	4,3	4,0	4,3	4,4	6,0	8,0	9,7	8,3	5,9
1931	7,8	7,3	6,8	5,3	4,0	5,3	5,1	5,1	5,5	5,6	5,5	7,4	5,9
1932	6,8	7,3	5,3	5,0	3,8	4,1	3,4	4,2	5,3	6,2	5,5	4,5	5,1
1933	5,9	5,6	4,5	6,3	5,2	5,5	5,0	6,8	5,5	7,4	6,6	5,7	5,8
1934	6,0	9,1	5,7	4,1	4,3	3,5	4,2	4,0	4,3	6,0	6,0	5,6	5,2
1935	6,0	6,1	4,9	4,6	3,9	3,4	5,9	4,6	6,0	6,7	7,0	5,7	5,7
1936	5,7	7,0	5,3	4,3	4,1	3,4	3,1	4,7	4,2	5,5	4,9	6,1	4,7
1937	8,0	4,2	5,0	4,1	3,7	3,9	3,4	3,2	5,0	4,5	4,8	5,2	4,6
1938	6,0	5,3	6,7	5,6	4,6	4,6	3,2	3,8	3,5	5,9	5,8	7,1	5,2
Mean long-term	6,2	6,0	5,0	4,7	4,1	4,1	4,1	4,3	4,8	5,8	5,8	6,1	5,1
Jastarnia													
1928	3,4	3,5	2,5	2,4	1,8	2,8	2,5	2,1	2,0	2,3	3,8	2,8	2,7
1929	3,4	2,0	3,2	2,7	2,3	2,2	2,3	1,7	2,9	4,0	4,0	5,2	3,0
1930	3,0	2,6	3,2	3,0	2,1	1,6	2,3	2,9	2,9	3,9	5,5	4,4	3,1
1931	4,5	3,4	4,7	2,7	1,7	3,5	2,5	2,4	4,3	4,7	3,8	6,5	3,7
1932	5,3	5,9	3,9	3,3	2,4	2,7	1,6	2,1	3,4	3,6	3,8	2,8	3,4
1933	3,8	3,7	2,7	3,6	2,0	2,2	2,3	3,9	4,0	5,0	3,7	3,6	3,4
1934	4,4	6,6	3,4	2,3	3,1	2,1	3,1	5,1	5,2	5,8	5,0	5,1	4,3
1935	5,0	4,9	3,8	3,9	3,2	3,2	4,2	2,6	3,8	5,0	4,4	4,2	4,0
1936	4,0	4,3	2,2	3,3	2,5	2,2	2,2	3,3	3,4	5,2	3,6	5,1	3,5
1937	5,8	3,9	3,8	3,2	2,4	2,7	2,0	1,5	3,7	3,3	3,1	3,4	3,2
1938	4,5	3,5	5,8	4,4	3,3	4,4	1,8	3,1	2,3	4,8	4,3	5,0	3,9
Mean long-term	4,3	4,0	3,6	3,3	2,4	2,7	2,4	2,8	3,4	4,3	4,1	4,4	3,5
Chałupy													
1928	6,3	5,2	4,5	3,8	2,5	4,9	3,8	3,5	2,6	3,6	4,7	4,6	4,1
1929	4,6	4,2	4,3	4,8	3,5	3,8	3,4	2,9	4,3	3,4	3,8	5,9	4,1
1930	3,9	3,4	4,0	3,2	2,6	2,1	3,6	3,5	3,6	5,3	6,9	5,1	3,9
1931	5,4	4,3	5,4	3,6	2,0	5,1	3,7	4,1	5,9	5,8	4,9	8,5	4,9
1932	6,5	7,2	5,0	4,6	3,6	3,8	3,2	4,0	5,2	5,2	4,9	7,0	4,8
1933	4,8	5,0	4,1	4,0	3,2	3,8	3,6	5,0	5,0	6,0	4,8	4,3	4,5
1934	5,3	8,2	4,4	3,6	4,5	3,7	4,1	4,3	3,4	5,2	4,8	4,6	4,6
1935	5,2	5,1	4,2	4,2	4,1	3,5	5,1	3,6	5,0	5,8	5,8	4,4	4,7
1936	4,2	5,6	2,8	3,6	3,0	2,9	3,2	3,8	3,7	5,6	4,0	5,7	4,0
1937	6,1	3,7	3,9	3,4	2,9	3,6	3,1	2,0	4,1	3,9	3,6	3,5	3,6
1938	4,3	4,1	6,0	4,7	3,7	4,4	3,4	3,5	2,8	5,2	4,4	4,7	4,1
Mean long-term	5,1	5,1	4,4	4,0	3,2	3,8	3,6	3,5	4,2	5,0	4,8	5,0	4,1

Year	Month												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Gdynia													
1928	4.5	4.0	3.4	3.0	3.1	4.5	3.8	3.6	2.9	3.6	2.8	4.0	3.7
1929	4.7	4.1	5.0	4.5	3.2	3.4	3.8	2.7	4.6	4.7	4.0	7.0	4.3
1930	4.1	5.0	4.9	4.4	3.6	3.1	4.0	4.8	4.4	4.4	6.1	5.8	4.9
1931	3.8	4.7	5.9	3.0	2.6	5.0	4.0	4.2	5.5	6.2	6.0	8.8	5.3
1932	7.0	7.0	4.6	4.5	3.1	3.8	2.4	3.5	4.3	4.9	4.9	3.6	4.5
1933	4.7	5.7	4.2	5.4	3.8	3.8	3.9	5.1	4.9	6.4	5.6	5.1	4.9
1934	5.4	9.4	4.8	4.6	5.0	3.9	5.4	5.1	4.7	5.3	6.0	7.7	5.8
1935	8.2	8.3	6.5	6.2	4.6	4.9	6.4	4.5	6.1	6.5	7.7	6.2	6.3
1936	6.7	7.8	3.0	4.1	3.3	3.4	2.8	4.3	4.2	5.9	4.7	6.2	4.7
1937	9.0	5.1	6.4	5.6	2.3	4.3	3.5	3.4	4.9	4.6	4.9	5.2	5.0
1938	7.1	6.2	8.8	7.3	5.5	6.3	3.8	4.5	4.6	7.2	6.5	9.4	6.4
Mean long-term	6.1	6.2	5.2	4.9	3.7	4.3	4.0	4.2	4.6	5.4	5.5	6.3	5.0
Puck													
1928	5.8	5.5	4.0	4.5	4.0	5.7	5.3	5.3	3.9	4.2	5.1	5.1	4.9
1929	5.4	5.4	6.6	6.1	4.3	4.8	5.1	3.4	4.9	4.4	4.0	6.1	5.0
1930	3.7	4.8	5.7	4.6	4.0	3.7	4.4	3.7	4.1	5.2	6.5	4.7	4.6
1931	5.4	4.5	7.1	4.1	3.0	5.0	4.1	4.2	5.3	5.7	4.4	8.3	5.1
1932	6.5	7.2	4.9	4.5	4.0	4.1	3.2	3.6	3.8	3.9	4.1	2.9	4.4
1933	3.8	4.4	3.6	4.5	3.6	3.9	3.7	3.8	4.4	5.2	4.5	4.5	4.1
1934	4.5	8.7	5.1	3.8	4.6	4.1	4.8	3.7	2.9	4.6	3.7	4.4	4.6
1935	5.2	6.3	5.3	4.6	5.0	3.9	5.9	3.8	5.3	5.8	4.7	4.7	5.0
1936	5.3	8.0	3.7	5.0	5.1	4.0	3.9	5.1	4.9	7.0	5.1	6.9	5.3
1937	9.2	4.8	5.5	6.8	4.7	4.6	3.8	3.3	5.2	4.7	3.5	4.1	5.0
1938	6.4	6.7	10.7	7.8	6.3	5.7	3.1	4.0	3.3	6.0	4.8	7.1	6.0
Mean long-term	5.5	6.0	5.7	5.1	4.4	4.5	4.3	4.0	4.4	5.2	4.6	5.4	4.9
Rozewie													
1928	5.2	4.3	2.9	2.1	1.8	3.1	3.1	2.8	2.0	1.7	2.7	2.6	2.9
1929	3.2	3.9	5.0	3.9	2.3	2.0	2.0	3.1	4.8	5.9	4.0	5.8	3.8
1930	3.9	3.3	4.6	3.2	3.2	2.3	3.9	4.1	4.0	5.1	6.4	5.0	4.1
1931	5.2	4.3	5.3	3.1	3.0	7.0	4.1	3.7	5.8	8.1	5.4	6.4	4.9
1932	7.6	7.9	5.1	4.2	3.4	3.4	2.9	4.1	5.3	5.0	5.8	4.1	4.7
1933	4.8	5.3	5.7	5.8	3.5	2.7	3.8	6.1	5.2	6.8	5.1	5.4	5.0
1934	6.0	9.0	4.4	3.0	4.3	2.8	3.7	2.5	2.5	5.2	5.0	5.1	4.4
1935	5.6	7.1	3.8	4.3	3.1	3.2	5.8	3.3	5.5	6.9	5.6	4.5	4.9
1936	5.4	5.6	2.3	2.5	2.0	2.6	2.8	4.1	3.2	5.4	4.2	7.7	4.0
1937	9.7	6.1	5.4	4.4	3.9	4.7	3.2	1.7	5.5	4.8	4.9	4.6	4.9
1938	7.6	6.1	10.2	6.0	4.0	6.5	2.7	2.3	3.8	6.1	8.1	9.7	6.1
Mean long-term	5.8	5.7	5.0	3.9	3.1	3.6	3.5	3.4	4.3	5.5	5.2	5.7	4.6
Karwia													
1928	4.2	4.0	3.3	3.4	3.5	6.4	4.4	4.1	2.8	4.7	3.9	4.1	3.9
1929	4.5	4.2	3.5	5.0	2.8	3.7	3.4	2.8	4.5	4.2	2.7	4.9	3.8
1930	2.9	3.3	4.1	2.8	2.0	2.0	3.9	3.8	3.8	4.6	7.7	4.9	3.8
1931	5.7	4.6	6.3	3.7	2.0	4.3	3.9	3.7	5.2	6.2	4.0	7.9	4.8
1932	5.7	7.1	4.6	3.8	3.2	3.2	2.2	3.6	4.3	4.8	4.4	2.4	4.2
1933	4.1	4.0	3.6	4.6	3.1	3.6	3.4	3.7	5.1	6.2	4.8	4.9	4.3
1934	5.2	8.9	3.9	3.2	4.3	3.1	4.4	3.2	2.8	4.5	5.2	3.7	4.4
1935	4.6	5.5	3.8	3.7	3.7	3.3	4.4	3.3	4.9	5.5	4.2	4.0	4.2
1936	4.3	5.5	2.7	3.4	3.4	3.1	2.8	3.9	3.7	5.0	3.7	6.6	3.7
1937	6.5	4.9	4.2	3.8	3.3	3.5	3.2	2.8	4.6	3.3	3.6	3.4	3.9
1938	5.8	4.6	6.9	5.2	3.7	5.8	2.9	3.6	3.2	4.8	3.8	4.4	4.8
Mean long-term	4.9	5.3	4.3	3.9	3.2	3.8	3.5	3.5	4.1	4.9	4.4	4.7	4.2

Mean monthly and annual pressures for Hel station (in mm Hg) 1931-1938

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
1931	755,8	761,3	760,0	759,6	761,2	761,3	758,3	758,1	759,4	761,0	768,7	760,2	760,3
1932	67,5	66,6	62,5	56,8	58,7	60,9	59,0	62,6	59,4	54,6	65,2	68,2	61,8
1933	69,5	59,4	61,0	60,9	59,9	57,3	61,6	60,5	62,7	61,1	61,2	65,7	62,0
1934	66,3	62,2	57,4	61,2	62,4	61,1	57,6	59,6	64,1	58,1	61,1	61,6	61,1
1935	62,3	50,1	65,9	56,6	62,9	61,3	53,1	60,7	57,4	56,0	62,3	56,3	59,9
1936	53,3	57,6	60,7	57,7	61,9	61,2	59,0	60,9	62,5	57,3	61,0	63,0	59,6
1937	67,7	52,2	55,1	59,5	63,2	61,3	59,1	60,5	59,2	63,7	60,6	59,9	60,1
1938	55,0	65,1	60,1	57,1	61,0	60,1	61,0	59,7	63,6	59,1	60,3	65,5	60,7
Mean long-term	762,2	759,1	760,8	758,6	761,4	760,6	759,1	760,3	761,0	758,9	762,1	762,6	760,7

Daily mean pressures for Hel station (in mm Hg) 1931-1938

Day	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	762,5	757,5	756,0	759,9	762,0	759,7	761,3	760,1	757,6	762,4	761,0	757,4
2	61,0	55,0	59,4	58,5	62,7	59,9	60,6	60,0	58,6	58,7	61,5	58,0
3	59,9	55,4	62,2	57,5	63,2	60,3	61,1	63,9	59,2	58,2	61,4	57,0
4	60,3	58,8	63,4	57,4	62,2	61,4	60,8	61,3	60,3	58,1	63,4	58,2
5	57,8	60,2	62,8	57,0	63,3	60,6	60,0	62,2	58,8	57,9	61,9	56,1
6	58,6	60,0	59,6	55,5	64,3	60,7	59,1	62,3	59,1	63,0	60,7	57,0
7	58,4	63,3	59,8	55,1	60,8	62,4	61,2	60,8	57,8	64,1	59,7	61,0
8	62,7	62,3	61,8	57,0	61,1	61,5	61,1	60,2	58,7	62,0	59,1	65,2
9	65,0	63,8	60,6	59,6	61,8	61,9	60,3	60,5	60,4	60,1	59,1	66,2
10	65,4	59,5	60,4	60,9	61,1	62,1	60,0	60,6	62,4	59,2	59,8	64,8
11	763,6	757,4	760,1	760,0	762,4	760,3	759,2	762,2	762,4	759,5	759,5	760,0
12	62,8	58,7	59,1	60,0	61,7	61,0	58,3	60,6	60,4	59,4	60,2	65,6
13	63,7	59,2	58,7	58,4	60,0	62,4	58,4	58,0	58,7	60,4	62,4	64,8
14	62,6	59,9	57,3	59,4	60,3	62,9	57,4	57,1	61,0	58,7	63,6	62,2
15	62,6	60,7	56,8	59,8	61,6	61,1	58,3	58,4	63,4	58,6	64,0	59,1
16	60,9	60,4	57,6	58,5	60,6	61,5	57,1	60,3	64,4	60,0	63,2	61,3
17	58,8	59,8	58,4	56,7	60,8	60,9	58,6	59,0	62,9	59,0	62,8	63,2
18	58,5	64,7	59,0	55,9	61,2	59,0	59,2	59,1	61,7	57,8	66,1	65,4
19	61,6	61,6	61,6	58,1	62,6	58,5	58,0	59,6	60,3	57,4	67,8	65,2
20	65,1	59,1	62,2	59,9	62,5	57,7	59,0	58,8	59,3	56,9	68,4	65,3
21	769,6	759,2	761,9	758,4	761,8	760,8	758,2	759,5	761,1	759,7	766,0	765,9
22	70,1	56,2	61,9	57,4	61,9	62,0	58,2	59,6	62,6	63,1	65,4	66,8
23	69,4	54,4	63,0	57,0	62,2	60,8	58,9	58,6	61,4	62,8	66,9	66,6
24	68,5	59,1	64,4	59,1	60,8	60,1	59,6	59,0	61,1	57,9	66,2	66,1
25	64,7	61,3	65,4	58,6	60,2	59,4	59,2	60,1	59,9	56,3	61,5	61,9
26	62,0	58,9	61,6	60,4	61,0	59,8	58,2	62,9	61,2	57,5	61,6	65,3
27	60,1	59,9	61,8	61,4	60,6	60,5	58,6	63,0	63,6	58,9	60,1	63,9
28	60,3	58,7	61,2	62,2	60,5	59,8	58,5	62,2	61,5	54,1	62,8	64,7
29	57,7	59,8	61,6	62,3	61,2	58,4	58,1	62,0	65,0	55,2	65,5	61,2
30	57,9		62,4	62,0	59,4	61,1	58,2	61,1	64,0	54,6	63,0	61,2
31	60,8		61,7		57,5		61,6	60,2		57,2		61,0

Monthly amounts of precipitation in mm for the stations: Hel, Jastarnia, Chałupy, Gdynia, Puck, Karwia 1928-1938 /3

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1928	4,1	49,2	13,2	32,3	48,2	122,2	40,1	53,2	54,5	65,6	54,0	36,3	573,0
1929	35,4	23,7	5,2	35,1	45,2	36,5	30,0	13,7	82,5	44,8	32,2	33,1	417,4
1930	8,6	21,3	28,1	41,0	49,2	7,7	66,4	140,1	91,6	87,8	57,8	14,1	614,2
1931	45,5	37,2	30,4	47,0	24,0	62,8	150,7	76,1	98,4	54,2	14,7	64,0	705,2
1932	8,3	23,1	16,2	36,5	123,1	36,7	44,6	65,6	49,2	66,9	24,2	19,0	513,7
1933	18,6	41,5	14,5	21,6	59,8	86,5	49,5	61,4	72,0	38,5	28,6	26,9	519,4
1934	16,5	19,6	58,9	21,2	38,4	65,3	92,1	67,4	29,0	55,6	51,1	17,9	555,0
1935	27,8	48,9	22,9	25,2	16,0	76,2	71,4	28,2	45,8	80,2	15,0	15,0	472,6
1936	34,6	23,7	26,8	31,3	34,5	85,7	104,6	63,1	52,4	120,7	20,7	26,0	639,1
1937	18,9	43,1	63,1	38,5	33,7	60,2	79,1	46,6	60,1	36,9	49,6	78,1	608,1
1938	30,9	4,3	35,5	33,9	19,1	39,4	67,4	55,2	40,6	54,7	19,1	31,0	440,1
Mean	23,3	32,0	28,6	34,1	46,7	63,6	72,4	61,0	61,5	64,2	33,4	32,9	551,1/550,7
%	4,2	5,8	5,2	6,0	8,4	11,5	13,1	11,1	11,3	11,6	6,1	6,0	100,0
Jastarnia													
1928	18,2	22,7	9,4	3,2	37,5	98,8	31,1	40,8	61,5	52,4	35,3	35,3	452,2
1929	9,0	15,0	2,9	12,4	89,2	23,7	25,7	7,9	50,4	39,0	27,6	17,4	320,2
1930	3,8	10,5	21,0	48,6	56,7	13,5	63,0	49,7	88,2	80,0	33,3	11,7	480,0
1931	35,8	15,8	32,6	33,2	25,8	59,9	113,0	49,8	82,2	41,3	9,4	42,6	532,4
1932	5,7	9,2	9,1	40,9	105,1	30,1	31,4	42,4	30,5	39,5	19,9	3,9	367,7
1933	5,7	12,6	6,5	7,3	45,4	81,7	28,3	67,8	67,5	25,7	24,3	4,8	374,6
1934	2,7	1,6	41,1	18,9	12,4	31,6	43,6	24,4	10,4	64,5	45,3	27,8	324,8
1935	27,3	40,2	29,5	42,0	40,8	54,5	53,4	27,7	72,6	74,0	18,3	11,1	497,5
1936	29,2	37,2	18,6	27,3	23,5	106,9	126,3	82,0	51,0	140,2	25,1	34,9	702,2
1937	18,7	36,2	58,1	17,8	49,9	53,1	107,5	49,6	68,0	26,8	50,8	73,2	609,3
1938	36,7	1,2	25,0	43,9	17,8	23,4	98,0	73,3	46,6	41,5	18,5	29,1	455,0
Mean	17,5	18,4	24,1	26,9	46,4	51,7	65,4	47,6	57,2	56,8	27,7	26,5	495,2 465,1
%	3,7	3,9	5,0	5,8	10,0	11,1	14,1	10,2	12,3	12,2	6,0	5,7	100,0
Chałupy													
1928	17,7	30,2	9,3	5,3	37,5	94,3	27,5	73,3	74,6	49,1	42,3	41,9	503,5
1929	6,3	9,7	4,2	38,2	110,0	12,6	34,3	12,4	48,5	33,5	33,0	29,7	371,9
1930	3,1	14,0	23,6	41,5	46,0	15,7	71,5	35,3	105,5	76,1	45,7	9,3	490,6
1931	34,0	18,6	39,4	36,1	29,2	49,3	93,1	58,0	93,6	59,5	11,0	59,1	580,9
1932	5,1	20,1	17,1	35,8	92,9	31,4	55,3	123,5	42,7	66,3	16,1	11,4	514,7
1933	8,6	25,4	6,7	18,2	44,8	42,1	29,1	60,9	72,0	31,4	33,1	14,7	378,0
1934	13,3	11,2	43,3	30,5	23,0	61,3	84,9	25,5	24,9	68,7	43,5	15,9	449,6
1935	22,0	31,7	27,7	19,8	17,9	67,1	46,0	18,2	51,2	105,1	18,8	10,2	488,7
1936	30,3	20,8	23,7	32,5	26,6	71,9	128,6	64,7	60,4	124,3	10,0	18,8	614,6
1937	14,6	33,3	91,5	26,2	33,2	63,6	126,9	54,3	63,3	24,4	36,7	72,8	650,3
1938	33,4	1,7	31,2	31,2	25,8	31,4	71,9	52,0	64,8	69,0	31,1	33,9	481,6
Mean	17,2	19,1	23,3	29,5	44,9	49,9	69,3	55,0	64,2	64,3	29,3	28,4	499,7 499,6
%	3,4	3,8	4,6	5,9	9,0	10,0	13,9	11,0	12,8	12,7	5,9	5,7	100,0

Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gdynia													
1928	40,8	38,5	11,5	9,9	45,3	98,8	27,1	76,2	45,2	35,2	59,9	43,8	532,2
1929	28,7	12,3	8,6	41,6	78,8	38,2	34,1	8,9	70,3	43,9	36,3	44,8	447,0
1930	5,5	19,6	33,3	55,0	61,4	17,5	100,0	57,5	107,0	94,1	73,9	17,7	643,2
1931	50,4	45,0	39,0	59,3	32,9	81,5	97,1	72,4	105,1	59,5	12,6	71,1	725,9
1932	4,8	15,2	17,0	40,0	113,0	63,6	60,1	161,8	35,0	60,9	20,1	14,8	606,3
1933	10,9	28,1	18,8	23,3	58,1	84,7	38,5	62,7	96,4	38,7	22,8	30,8	513,8
1934	16,9	23,0	55,4	18,1	34,8	74,6	98,9	56,9	29,6	69,0	62,8	11,2	542,2
1935	23,3	45,4	16,3	23,9	22,7	39,5	66,9	55,4	48,4	94,0	10,8	15,1	461,7
1936	27,0	37,5	22,6	41,2	25,0	95,1	99,8	79,6	54,5	142,5	12,5	20,0	657,3
1937	19,0	34,4	63,6	26,5	64,5	42,2	74,8	51,1	65,2	20,0	50,1	57,6	569,0
1938	22,6	6,2	30,8	53,4	28,6	24,5	81,0	57,5	46,5	52,1	23,0	12,4	438,6
Mean	22,7	27,8	28,8	35,7	51,4	60,0	70,8	67,3	64,0	63,6	35,0	30,9	558,0 557,9
%	3,9	5,0	5,2	6,4	9,2	10,8	12,7	12,1	11,5	11,4	6,3	5,5	100,0
Puck													
1928	30,9	35,0	10,8	5,8	39,0	85,2	31,6	63,1	68,1	65,1	63,9	45,3	545,4
1929	35,5	14,7	10,1	55,0	123,8	28,5	15,2	10,5	74,9	69,2	45,7	56,3	566,4
1930	11,0	31,0	40,0	50,0	44,0	14,1	110,9	35,0	109,3	117,3	77,2	15,0	653,0
1931	54,9	30,4	36,0	37,7	44,4	49,8	91,1	77,5	89,5	38,0	10,6	70,8	631,0
1932	4,8	15,0	20,0	28,1	65,6	9,7	95,8	155,2	52,2	80,2	22,1	9,1	557,8
1933	6,3	21,9	8,1	18,5	37,2	43,0	24,0	48,0	67,6	15,0	23,1	24,0	336,7
1934	20,7	16,5	68,4	32,4	28,2	58,4	121,3	54,3	36,2	60,1	44,6	21,1	562,2
1935	24,0	59,9	24,3	16,0	12,0	40,1	50,0	50,0	50,2	97,2	10,3	14,0	400,0
1936	36,7	43,2	36,8	37,2	19,7	90,7	116,7	85,0	52,7	150,3	16,8	29,9	715,7
1937	28,8	37,3	58,9	32,6	44,0	70,1	127,1	87,4	63,0	23,8	47,5	74,4	694,9
1938	44,3	12,8	21,5	30,9	26,2	33,5	108,1	59,2	56,6	65,0	36,0	36,7	530,8
Mean	27,0	28,9	30,4	31,5	44,1	47,6	84,7	65,9	65,4	70,6	36,9	36,1	569,1
%	4,7	5,1	5,3	5,5	7,7	8,4	15,0	11,6	11,5	12,4	6,5	6,3	100,0
Karwia													
1928	38,3	38,4	13,0	9,2	38,1	81,0	47,7	80,8	66,0	78,9	56,9	47,0	597,5
1929	23,0	16,5	11,7	60,0	122,4	14,5	81,2	11,6	53,1	62,3	50,6	53,3	560,2
1930	8,6	21,0	22,3	32,9	51,6	34,5	82,6	93,8	104,2	125,8	96,3	14,5	688,0
1931	56,2	33,2	42,9	59,6	36,7	64,6	109,5	55,6	113,4	63,3	8,9	55,2	699,1
1932	11,2	23,9	14,4	43,7	97,7	31,5	55,6	85,3	77,3	100,4	27,8	17,0	591,8
1933	7,8	45,7	15,2	22,2	48,8	58,4	62,7	79,9	110,1	58,3	63,3	27,0	599,2
1934	18,6	20,9	59,5	9,4	9,0	76,8	131,6	56,1	53,7	59,3	58,4	22,3	575,6
1935	29,0	64,4	27,8	16,7	16,3	61,5	71,8	58,2	58,2	119,4	43,4	19,2	585,9
1936	38,3	40,6	31,9	47,7	22,9	90,6	53,4	90,4	88,3	161,9	17,9	43,9	727,8
1937	26,8	51,1	81,6	43,7	62,4	87,2	184,1	69,1	96,5	21,6	45,3	97,0	869,9
1938	40,4	15,4	38,3	44,8	17,8	45,0	138,9	77,3	52,4	62,4	41,5	34,5	608,7
Mean	27,1	33,8	32,6	35,4	47,6	58,8	92,6	68,9	78,5	83,9	46,5	39,2	644,9 645,0
%	4,1	5,2	5,1	5,5	7,4	9,1	14,4	10,7	12,2	13,0	7,2	6,1	100,0

Number of days with precipitation for the stations: Hel, Jastarnia, Chałupy, Gdynia, Puck 1928-1938

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Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel													
1928	12	11	2	7	14	17	13	12	13	15	16	15	147
1929	13	9	12	16	11	9	13	6	10	13	11	15	138
1930	7	9	8	16	14	3	11	14	17	20	18	13	150
1931	23	12	20	13	10	10	20	19	20	16	6	20	189
1932	7	14	13	12	15	11	9	11	13	17	15	12	149
1933	10	19	6	9	12	14	9	7	14	9	10	18	137
1934	12	10	10	6	9	5	17	12	8	11	18	9	127
1935	18	16	12	11	7	10	14	12	15	16	11	9	151
1936	17	18	11	13	11	10	16	17	13	22	12	9	169
1937	13	19	18	9	6	14	15	8	10	7	13	16	148
1938	23	8	12	18	10	11	14	7	10	19	10	11	151
Mean	14	13	11	12	11	10	14	11	13	15	13	13	150
Jastarnia													
1928	8	11	2	3	11	16	8	14	12	12	14	13	124
1929	9	12	5	7	8	10	9	3	7	13	10	12	105
1930	1	7	9	17	9	3	11	8	16	15	9	1	109
1931	21	5	12	7	8	9	15	13	16	7	4	16	133
1932	2	6	8	9	11	9	6	5	9	18	9	6	98
1933	2	6	4	5	10	14	8	6	11	9	8	2	85
1934	3	4	6	7	7	2	13	5	5	6	14	11	83
1935	15	18	16	9	8	9	13	10	20	22	11	13	164
1936	17	19	13	16	9	8	19	11	16	21	13	12	174
1937	12	16	17	9	6	11	14	6	12	7	14	19	144
1938	4	11	14	10	10	16	11	10	19	12	11	17	145
Mean	9	10	10	9	9	10	12	8	13	13	11	11	125
Chałupy													
1928	11	14	3	5	11	18	12	14	17	21	23	18	167
1929	14	16	3	14	16	10	9	4	9	20	12	18	150
1930	6	12	11	16	12	6	17	15	20	20	19	10	164
1931	10	13	19	13	10	10	15	19	24	14	7	19	182
1932	7	13	12	11	15	10	9	9	17	21	14	8	149
1933	7	11	7	8	12	15	9	10	16	10	9	12	126
1934	11	8	8	7	10	6	15	8	8	11	14	6	112
1935	12	11	10	11	7	8	10	7	18	19	10	9	132
1936	19	17	11	14	10	6	18	13	14	21	11	6	160
1937	10	11	19	6	7	9	12	7	12	6	10	17	126
1938	15	5	9	14	10	8	12	9	11	18	8	12	131
Mean	11	11	11	11	11	11	13	10	15	17	12	12	145

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Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gdynia													
1928	16	16	2	10	16	16	15	16	18	15	21	16	175
1929	11	11	7	18	13	11	11	[illegible]	9	14	11	17	137
1930	7	13	13	16	12	6	20	12	20	21	21	14	175
1931	23	17	22	16	11	10	18	17	19	18	7	22	200
1932	6	12	13	12	14	12	8	11	16	23	11	8	146
1933	8	18	7	12	11	15	6	12	13	11	13	18	144
1934	13	11	10	8	11	8	19	14	11	13	16	13	147
1935	13	16	10	12	10	9	11	10	15	16	9	8	139
1936	17	19	12	15	9	9	15	12	11	19	7	9	154
1937	9	16	18	11	7	11	12	8	10	6	12	17	137
1938	21	6	11	14	11	11	14	7	10	17	8	9	139
Mean	13	14	11	13	11	11	14	11	14	16	12	14	154
Puck													
1928	16	14	2	6	11	18	16	13	14	16	20	16	162
1929	12	19	9	17	12	8	8	3	7	17	12	18	142
1930	6	13	13	16	12	6	15	12	22	19	20	15	169
1931	22	12	22	12	10	11	16	20	21	13	5	21	185
1932	9	14	14	11	15	10	12	12	17	24	13	6	157
1933	10	16	7	11	12	15	11	9	16	13	18	16	154
1934	14	10	13	9	10	7	17	8	7	10	16	7	128
1935	15	16	14	12	6	7	14	8	19	18	9	11	149
1936	19	19	12	16	7	10	18	14	13	21	14	16	179
1937	14	23	20	10	7	11	14	8	13	6	17	20	163
1938	21	6	11	18	8	12	12	11	13	18	10	16	156
Mean	14	15	12	13	10	10	14	11	15	16	14	15	159
Karwia													
1928	10	7	2	5	10	17	9	10	11	12	20	14	127
1929	10	9	5	10	11	6	8	4	7	17	14	14	115
1930	3	11	12	12	10	6	16	9	18	18	18	9	142
1931	21	11	19	12	7	9	8	12	19	15	5	17	155
1932	9	12	9	8	14	9	9	12	16	22	10	5	135
1933	5	14	7	8	10	12	11	7	15	9	14	11	123
1934	12	11	7	5	4	6	16	9	4	7	13	10	104
1935	13	14	10	9	5	11	11	8	17	19	9	8	134
1936	16	17	9	14	7	8	15	10	11	22	12	13	154
1937	12	18	17	12	8	11	13	10	12	5	17	19	154
1938	21	4	13	11	8	10	14	9	11	10	10	11	140
Mean	12	11	10	10	8	10	12	9	13	15	13	12	135

Number of days with snow cover for the stations: Hel, Gdynia, Karwia 1928-1938

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Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel													
1928	7	4	.	.							.	13	24
1929	31	28	16	4							.	.	79
1930	.	.	2	.							2	16	20
1931	21	28	29	1							.	11	90
1932	6	21	24	.							.	.	51
1933	23	16	13	.							.	20	72
1934	4	7	2	1							.	.	14
1935	15	14	3	.							2	2	36
1936	5	21	3	.								.	29
1937	12	18	10	.							1	14	55
1938	16	.	1	.							.	14	31
Mean	13	14	9	1	.	.	.	.	.	.	0,5	8	45/46
Gdynia													
1928	14	7	.	.							.	14	35
1929	31	28	13	5							.	1	78
1930	.	10	3	.							6	15	34
1931	20	24	27	1							2	13	93
1932	2	19	13	.							.	5	39
1933	25	16	0	.							.	20	70
1934	3	7	3	1							.	.	14
1935	16	13	3	.							2	7	41
1936	9	23	3	.								1	36
1937	2	12	11	.							5	26	56
1938	16	1	.	1							.	11	29
Mean	13	15	8	1	.	.	.	.	.	.	1	10	48/48
Karwia													
1928	16	11	.	.							.	13	40
1929	31	28	14	.							.	.	73
1930	.	6	2	.							.	6	14
1931	20	25	28	.									73
1932	5	12	18	.							.		42
1933	22	13	10	.								10	55
1934	2	8	.	.								6	16
1935	19	10	2	.							2	6	39
1936	3	12	2	.							.	1	18
1937	9	10	12	.							2	15	48
1938	17	.	.	1							.	13	31
Mean	13	13	8	0.1							0.4	6	40/41

Number of days with snow precipitation for the stations: Hel, Gdynia, Karwia 1928-1938 /4

Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	XI	X	XI	XII	
Hel													
1928	3	1	1	3								12	22
1929	13	9	6	9								3	40
1930	3	7	3	1								4	27
1931	18	12	17	6						2		11	66
1932	2	13	10	.								.	25
1933	8	12	2	2								10	34
1934	7	5	2	1								3	18
1935	11	9	5	1							5	5	36
1936	9	15	5	2							1	.	32
1937	6	13	13	.							6	12	50
1938	9	2	2	6								8	27
Mean	8	9	6	3						0.0	1	7	34
Gdynia													
1928	10	10	.	1							1	10	32
1929	11	11	4	7							.	2	35
1930	2	10	4	3							4	10	33
1931	21	13	10	5						3		12	72
1932	1	12	9	.								2	24
1933	6	10	4	3								13	36
1934	7	7	2	1								2	19
1935	9	10	6	3							2	5	35
1936	8	15	5	1							1	2	32
1937	4	11	13	.							9	16	53
1938	12	3	3	10								8	36
Mean	8	10	6	3						0,0	2	7	36 37
Karwia													
1928	2	3	.	.							1	8	14
1929	9	9	1	6								.	25
1930	6	5	3	.								7	21
1931	15	9	12	2								3	41
1932	.	8	3	.								.	11
1933	3	8	2	.							1	4	18
1934	5	6	1	.								4	16
1935	7	1	3	2							3	4	20
1936	2	15	4	.								1	22
1937	5	11	13	.							9	14	52
1938	13	2	5	7								10	37
Mean	6	7	4	2							1	5	25

Mean monthly relative humidity for Hel station and Gdynia station 1928-1938

/4

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1928	85	84	67	81	83	84	82	71	73	83	89	87	81
1929	83	84	85	80	82	82	87	91	89	90	90	86	84
1930	90	88	85	86	87	77	83	93	87	88	85	90	87
1931	91	89	86	85	82	77	84	85	81	81	83	85	84
1932	87	78	80	85	86	77	80	80	83	86	86	89	83
1933	88	86	84	79	83	84	81	79	84	82	86	86	83
1934	88	84	88	81	74	74	85	85	87	87	89	92	84
1935	87	85	85	79	74	88	84	86	85	89	88	88	85
1936	90	83	89	81	81	85	80	82	81	83	87	89	84
1937	82	90	86	84	81	78	85	86	79	81	86	89	84
1938	89	82	79	77	74	77	83	81	83	82	85	81	81
Mean	87	83	83	81	81	80	83	84	83	85	87	87	84
Gdynia													
1928	86	81	72	77	74	70	68	79	81	84	88	90	79
1929	87	84	84	81	77	72	75	74	73	83	88	86	80
1930	86	89	81	83	76	70	78	80	84	85	86	88	82
1931	89	91	82	81	75	70	78	83	79	79	81	84	81
1932	84	79	81	77	83	74	79	78	81	82	84	90	81
1933	90	87	80	74	80	79	74	74	81	79	85	81	81
1934	87	81	86	79	70	69	81	79	81	80	82	81	80
1935	82	80	76	71	70	70	73	77	76	84	85	87	78
1936	88	83	88	77	81	80	78	81	79	78	85	84	82
1937	78	86	80	80	74	72	77	83	75	81	83	87	80
1938	84	76	69	75	68	65	76	77	79	79	82	84	76
Mean	86	83	80	78	75	72	76	79	79	81	84	87	80

Mean monthly cloud cover for the stations: Hel, Gdynia, Karvia 1928-1938

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1928	6,3	6,2	3,4	5,6	4,8	5,5	4,7	5,8	4,1	5,4	6,4	6,9	5,4
1929	6,2	6,1	5,3	4,5	4,5	4,4	4,4	3,7	4,3	6,2	6,7	7,2	5,3
1930	7,4	7,7	6,3	6,3	5,7	5,3	6,0	6,4	7,3	7,6	7,9	9,2	6,8
1931	9,2	9,1	7,0	7,1	5,9	6,1	6,7	6,6	7,5	6,9	7,2	8,2	7,3
1932	8,2	7,7	7,0	6,8	7,4	5,7	5,4	5,4	6,7	7,7	7,0	7,4	6,9
1933	9,4	7,5	6,7	6,6	6,6	5,9	5,7	5,8	6,0	6,7	7,8	7,9	6,9
1934	7,9	7,7	8,0	5,8	4,8	5,1	6,8	5,9	3,8	6,3	7,3	9,6	6,6
1935	7,7	8,5	6,6	5,6	5,0	5,2	6,2	5,8	5,8	7,6	7,6	8,9	6,7
1936	7,9	8,1	6,7	6,0	6,3	5,2	5,9	6,4	5,1	6,7	8,1	7,6	6,7
1937	5,8	6,7	7,3	7,5	5,1	4,7	5,7	5,4	5,5	5,9	7,6	9,1	6,5
1938	8,4	7,4	5,3	6,3	5,8	5,0	5,4	4,7	6,1	7,7	7,3	8,7	6,0
Mean	7,7	7,6	6,2	6,2	5,4	5,1	5,7	5,6	5,5	6,8	7,4	8,3	6,5

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Gdynia													
1928	7,7	7,8	7,4	6,3	6,1	6,5	5,9	6,5	5,1	6,2	7,9	7,6	6,5
1929	7,0	6,7	5,5	6,1	5,4	5,5	5,6	4,3	4,8	6,5	7,3	7,1	5,9
1930	7,1	7,6	6,4	6,5	5,7	5,6	6,4	6,1	7,0	6,6	6,9	8,6	6,6
1931	8,7	8,5	7,7	6,3	4,9	5,9	6,5	6,3	7,0	6,2	6,5	7,8	6,7
1932	6,9	7,4	6,0	6,0	7,1	5,2	5,3	5,9	6,1	7,3	6,8	7,1	6,3
1933	9,1	7,4	6,1	6,4	6,4	5,9	5,6	5,6	5,6	6,5	7,4	8,1	6,7
1934	7,5	7,8	7,5	5,4	4,6	5,2	6,5	5,9	4,0	5,7	7,0	9,4	6,4
1935	7,8	7,6	6,2	5,7	5,1	5,0	5,9	6,2	5,9	6,8	7,2	7,0	6,5
1936	7,7	8,1	6,8	6,2	6,7	5,3	6,3	6,2	5,3	6,9	7,7	7,2	6,7
1937	5,9	8,4	8,1	7,4	5,1	4,8	6,0	6,1	5,5	6,1	7,4	9,2	6,7
1938	8,2	5,9	5,1	7,2	5,0	6,1	6,4	5,5	4,7	8,0	6,6	8,4	6,5
Mean	7,6	7,6	6,2	6,3	5,8	5,4	6,0	5,8	5,5	6,6	7,2	8,0	6,5
Karwia													
1928	4,2	4,4	2,0	3,0	3,1	3,1	2,4	2,5	2,2	3,7	4,6	4,4	3,3
1929	3,7	4,7	3,9	3,1	3,4	2,4	2,2	1,4	2,3	4,6	5,4	6,3	3,6
1930	5,2	7,0	5,1	4,8	3,0	2,2	4,0	4,4	6,0	6,2	6,7	8,0	5,4
1931	8,7	8,2	5,7	5,3	4,0	4,8	5,2	5,2	5,7	5,6	6,0	7,8	6,0
1932	6,8	7,1	5,6	5,8	6,4	3,8	4,4	3,9	5,7	7,4	6,5	7,0	5,9
1933	8,2	7,3	6,6	6,2	5,8	4,7	4,3	4,1	4,9	5,0	6,6	7,1	5,9
1934	6,8	6,8	6,7	3,8	3,1	4,5	5,9	5,6	3,6	5,6	7,1	8,5	5,7
1935	6,8	7,1	5,6	4,8	4,0	4,3	5,5	5,6	5,8	6,9	7,2	8,3	6,0
1936	7,8	8,0	6,7	6,2	6,6	5,0	6,1	6,2	5,5	7,0	7,7	7,1	6,7
1937	5,6	8,2	7,5	6,8	4,3	4,6	5,8	5,5	5,0	4,9	7,1	9,1	6,2
1938	8,2	6,1	5,3	5,9	3,8	4,9	4,8	4,7	4,2	7,3	5,9	7,6	5,7
Mean	6,6	6,8	5,5	5,1	4,4	4,0	4,6	4,5	4,6	5,8	6,4	7,4	5,5

Mean annual cloud cover for specific observation terms 1928-1938

Year	Hel station			Gdynia			Karwia		
	7^h	13^h	21^h	7^h	13^h	21^h	7^h	13^h	21^h
1928	5,9	5,6	4,8	6,8	6,8	5,8	3,9	2,6	3,3
1929	6,0	5,3	4,8	6,5	6,2	5,2	4,6	3,0	3,2
1930	7,2	6,9	6,3	6,9	6,8	5,9	6,0	5,0	5,2
1931	7,7	7,4	6,7	7,0	7,1	6,0	6,5	5,7	5,8
1932	7,1	7,0	6,5	6,8	6,6	5,8	6,4	5,4	5,8
1933	7,2	7,0	6,4	7,0	6,9	6,1	6,3	5,3	6,0
1934	6,8	6,7	6,1	6,8	6,7	5,6	6,3	5,0	5,7
1935	7,1	6,7	6,3	6,8	6,7	5,9	6,4	5,7	5,9
1936	6,8	6,7	6,5	6,9	6,9	6,2	6,8	5,5	6,3
1937	6,9	6,6	6,1	7,0	7,0	6,0	6,3	6,4	5,8
1938	6,4	6,1	5,6	7,0	6,8	5,9	6,0	5,8	5,3
Mean	6,8	6,5	6,5	6,8	6,8	5,9	6,0	5,0	5,3

Number of overcast (cloudy) days for the stations: Hel, Gdynia, Karwia /4
1928-1938

Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel													
1928	6	10	2	6	4	1	3	3	1	3	6	16	61
1929	11	9	9	1	2	1	1	.	1	9	11	14	69
1930	15	15	12	12	8	2	10	9	17	13	16	26	155
1931	26	22	13	10	7	10	12	12	13	10	17	16	167
1932	17	15	14	13	14	7	2	6	10	15	9	15	137
1933	27	10	12	11	14	6	7	6	9	11	18	19	150
1934	19	14	18	7	4	6	11	7	3	9	13	28	139
1935	16	20	9	10	8	5	10	5	3	13	18	23	140
1936	16	16	18	8	8	7	7	12	7	9	18	21	147
1937	10	21	18	12	6	6	5	7	5	10	20	24	144
1938	21	10	6	8	5	4	3	5	3	13	13	20	111
Mean	17	15	12	9	7	5	8	7	7	10	14	20	129/130
Gdynia													
1928	18	17	7	10	12	10	8	7	5	8	17	17	136
1929	14	12	7	7	5	4	11	2	6	10	12	15	105
1930	13	16	15	13	9	2	10	7	11	14	13	22	145
1931	23	18	8	8	6	8	8	8	10	10	14	17	138
1932	15	15	11	8	12	8	2	6	8	15	8	12	120
1933	25	12	11	9	13	8	7	4	11	10	15	20	145
1934	18	14	13	7	2	7	10	7	3	6	13	28	128
1935	18	17	8	7	7	3	7	8	4	10	14	16	119
1936	15	18	16	11	9	5	8	10	6	11	16	14	139
1937	13	18	19	14	9	6	5	9	7	10	14	25	149
1938	18	11	8	11	7	8	5	9	8	19	11	20	133
Mean	17	15	11	10	8	6	7	7	7	11	13	19	131
Karwia													
1928	2	3	1	1	2		.	.	1	3	3	4	20
1929		3	4	.	3	1	2	.	1	5	4	10	33
1930	11	14	5	8	1	1	2	3	10	13	11	20	99
1931	22	19	8	8	5	5	4	5	8	6	13	17	120
1932	13	13	11	6	10	4	4	2	7	15	7	14	106
1933	16	9	12	7	11	5	3	2	8	3	10	14	100
1934	11	10	12	2	.	3	10	4	3	2	12	23	92
1935	9	11	8	6	3	2	6	8	4	12	13	21	103
1936	15	17	15	9	8	6	8	10	6	13	17	12	136
1937	11	18	16	10	5	3	7	6	3	6	15	25	132
1938	20	10	6	6	5	4	1	6	6	12	7	16	99
Mean	12	12	9	6	5	4	4	4	5	8	10	16	95

Number of clear days for the stations: Hel, Gdynia, Karwia /4
1928-1938

Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Hel													
1928	1	2	14	1	8	1	.	1	5	4	1	3	41
1929	4	4	4	5	6	6	9	7	7	3	2	1	58
1930	2	2	4	5	5	12	1	2	2	1	.		39
1931	.	.	1	1	5	2	3	3	1		3		19
1932	1	1	2	3	.	5	2	5		1	2	1	23
1933	.	.	5	1	4	2	1	1	5	1	2	1	26
1934	2	.	.	3	4	5	2	2	11	2	1		32
1935	2	.	1	5	6	3	3	3	2	1	2	.	28
1936	.	.	7	4	2	6	3	2	7	1	1	3	36
1937	7	1	2	1	8	8	4	6	1	4	1	.	43
1938	.	2	6	1	11	5	5	9	10	1	.	.	50
Mean	2	1	4	3	5	5	4	4	5	2	1	1	37.36
Gdynia													
1928	2	.	12	4	5	1	2	2	5	3	1	2	39
1929	2	4	4	4	4	4	5	7	5	1	1	3	44
1930	2	1	3	3	3	14	6	2	2	3	1	1	41
1931	.	.	4	2	7	1	2	2	.	1	5	1	25
1932	1	1	5	1	.	6	4	4	.	1	2	1	26
1933	.	.	6	2	5	3	4	1	7	1	2	1	32
1934	2	.	1	3	4	3	2	1	8	2	1	.	27
1935	1	.	1	4	4	3	5	1	1	.	2	1	23
1936	.	.	6	4	3	4	2	3	5	1	2	2	32
1937	6	.	1	1	6	7	2	2	3	4	2	.	34
1938	.	4	5	.	6	3	1	7	10	1	1	.	38
Mean	1	1	4	2	4	4	3	3	4	2	2	1	31.33
Karwia													
1928	8	7	21	13	13	11	17	14	12	9	6	5	136
1929	7	7	10	10	13	15	20	23	18	6	2	3	134
1930	5	3	7	7	11	19	6	9	3	5	2	1	78
1931	.	1	4	4	12	7	8	6	3	3	3	.	51
1932	3	2	5	5	1	11	5	10	3	2	3	4	54
1933	.	.	4	2	7	8	8	6	5	3	3	1	47
1934	2	.	1	7	8	2	3	1	10	2	.	.	36
1935	1	.	3	4	8	4	4	4	1		2	.	31
1936	.	1	6	3	3	6	3	3	2	1	1	3	32
1937	6	1	1	1	11	7	3	7	3	7	2	.	49
1938	.	2	6	.	9	5	4	10	11	1	5	1	54
Mean	3	2	6	5	9	9	7	9	6	4	3	2	64

Number of days with fog for the stations: Hel, Jastarnia, Chałupy, Gdynia, Rozewie, Karwia 1928-1938 /4

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1928	.	2	1	5	8	4	.	1	.	5	8	6	40
1929	3	2	13	.	10	1	2	3	.	5	6	7	52
1930	8	6	8	2	4	1	1	2	9	10	8	9	68
1931	3	7	8	11	6	3	3	1	2	6	3	3	56
1932	12	2	4	7	10	4	3	3	4	3	1	8	61
1933	7	2	7	1	9	.	1	.	3	2	5	7	44
1934	10	4	10	7	1	1	6	2	3	4	3	10	61
1935	6	1	5	1	.	2	1	2	.	3	5	7	33
1936	6	5	10	6	3	3	2	1	.	1	1	.	38
1937	1	8	4	6	6	3	.	3	.	1	.	5	37
1938	2	3	1	3	2	2	2	2	.	2	5	2	26
Mean	5	4	6	4	5	2	2	2	2	4	4	6	47
Jastarnia													
1928	.	2	.	6	5	.	.	1	.	1	4	.	19
1929	1	.	6	.	4	.	1	.	.	3	2	4	21
1930	4	6	3	1	1	.	.	.	1	2	.	.	18
1931	.	.	.	.	.	.	.	.	.	.	.	.	.
1932	.	.	.	.	.	.	.	.	.	.	.	.	.
1933	.	.	.	.	5	.	.	.	2	.	.	2	10
1934	1	1	5	5	.	1	1	2	5	8	6	5	40
1935	4	4	4	.	.	1	.	1	.	4	6	3	27
1936	5	4	11	1	3	8	3	1	1	1	8	.	51
1937	1	4	3	5	3	1	1	2	1	2	3	1	28
1938	6	.	.	1	.	.	1	1	2	5	1	3	20
Mean	2	2	3	2	2	1	1	1	1	2	3	2	21
Chałupy													
1928	3	2	2	5	3	.	.	1	.	5	.	2	23
1929	3	.	6	.	4	.	.	.	1	5	9	5	33
1930	1	1	2	.	3	.	.	1	.	4	2	.	14
1931	.	.	2	3	1	2	1	.	.	.	2	.	11
1932	7	.	1	5	6	1	1	.	3	2	.	4	30
1933	.	.	3	.	4	1	.	.	.	.	.	5	13
1934	.	.	3	6	.	1	1	1	1	.	1	1	15
1935	.	.	2	.	.	1	.	1	.	.	3	2	9
1936	3	1	3	2	4	2	.	.	.	.	.	.	20
1937	.	1	2	4	3	1	.	.	.	1	2	.	14
1938	1	1	.	1	.	.	.	.	.	.	3	1	7
Mean	1	1	3	2	2	1	0,3	0,4	0,5	1	2	2	17

Year	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Gdynia													
1928	1	3	6	11	5	1	1	3	3	8	10	6	58
1929	11	6	9	2	10	1	2	11	7	11	16	9	95
1930	13	12	13	5	1	2	10	8	12	14	15	20	125
1931	18	22	15	10	7	4	3	3	6	10	7	12	124
1932	17	4	7	10	12	5	7	1	7	13	9	15	107
1933	13	11	14	1	8	3	1	5	9	6	14	10	95
1934	9	6	12	8	2	1	8	3	5	6	5	8	73
1935	1	1	3	.	.	1	1	2	.	2	7	8	26
1936	4	4	9	2	3	2		.	.	.	5	2	31
1937		2	4	5	2	1	1	3	.	2	2	2	24
1938	.	1	.	1	.	.	1	3	2	1	4	2	15
Mean	8	7	8	5	5	2	3	4	5	7	9	9	70
Rozewie													
1928	3	2	2	9	9	3	.	1	.	3	8	4	44
1929	2	.	6	3	12	5	3	.	2	6	16	10	65
1930	16	9	10	5	9	2	2	1	3	8	8	7	80
1931	6	1	4	10	4	3	4	1	2	4	12	10	61
1932	15	5	9	13	18	6	5	.	6	3	10	12	102
1933	2	3	8	2	11	3	2	.	2	.		2	35
1934	4	1	6	9	.	1	6	3	.	1	10	15	56
1935	7	7	4	1	6	7	3	6	6	11	11	6	75
1936	9	3	15	6	8	7	4	6	2	1	14	18	94
1937	7	7	3	8	3	3	1	2	1	7	7	4	53
1938	6	7	3	2	6	1	1	3	3	8	9	.	49
Mean	7	4	6	6	8	4	3	2	2	5	10	8	65
Karwia													
1928	1	4	9	8	4	2	.	1	8	6	.	2	45
1929	6	3	11	2	8	.	4	4	11	13	17	10	89
1930	9	4	13	3	4	2	5	3	8	10	7	1	69
1931	4	6	4	5	5	4	2	2	1	2	8	4	47
1932	10	2	5	7	8	4	3	2	7	7	4	10	69
1933	2	2	5	.	5	.	3	2	5	3	4	9	40
1934	6	6	6	4	.	1	2	2	8	6	2	6	49
1935	2	2	5	.	.	3	2	3	.	1	8	2	28
1936	7	3	9	4	7	3	.	1	4	6	19	13	76
1937	.	1	3	6	4	2	1	3	2	8	5	1	36
1938	2	7	2	.	2	.	2	3	1	6	5	3	33
Mean	4	4	7	3	4	2	2	2	5	6	7	6	53

Number of days with storms for the stations: Hel, Gdynia, Karwia /4
1928-1938

Year	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Hel													
1928	.	.	.	.	4	3	2	2	1	.	.	.	12
1929	.	.	.	.	4	2	2	2	2	1	.	1	14
1930	.	.	.	2	2	.	.	3	3	.	.	.	10
1931	.	.	.	.	6	5	6	5	2	.	.	.	24
1932	.	.	.	2	3	2	7	5	3	.	.	.	22
1933	.	.	1	.	.	4	3	3	1	.	.	.	12
1934	.	.	.	2	3	1	4	6	2	.	.	.	18
1935	.	.	1	.	1	6	4	2	1	2	.	.	17
1936	.	.	.	1	3	.	4	1	.	1	.	.	10
1937	.	.	.	.	1	6	5	4	1	.	.	.	20
1938	.	.	1	.	1	2	3	1	2	.	.	.	10
Mean	.	.	0,2	0,6	2,8	2,8	3,6	3,1	1,6	0,4	.	0,1	15,4
Gdynia													
1928	.	.	.	.	3	5	3	2	.	.	.	.	13
1929	.	.	.	.	5	1	2	4	1	1	.	.	14
1930	.	.	.	1	2	1	6	3	2	.	.	.	17
1931	.	.	.	.	5	4	4	4	.	.	.	.	16
1932	.	.	.	2	5	2	6	2	2	.	.	.	19
1933	.	.	.	.	.	8	3	3	2	.	.	.	16
1934	.	.	.	3	2	1	2	7	1	1	.	.	17
1935	.	.	.	.	1	6	6	2	3	1	.	.	19
1936	.	.	.	1	5	3	7	4	1	1	.	.	22
1937	.	.	.	.	5	6	6	5	1	.	.	.	23
1938	.	.	1	.	1	2	6	1	2	.	.	.	13
Mean	.	.	0,1	0,5	3,1	3,5	4,8	3,4	1,4	0,4	.	.	17,2
Karwia													
1928	.	.	.	.	.	.	.	.	.	.	.	.	.
1929	.	.	.	.	2	.	.	.	.	.	.	.	2
1930	.	.	.	1	1	.	1	.	1	.	.	.	4
1931	.	.	.	.	2	.	1	1	1	.	.	.	5
1932	.	.	.	.	1	.	2	.	1	.	.	.	4
1933	.	.	.	.	.	.	2	1	.	.	.	.	3
1934	.	.	.	.	.	.	.	2	1	.	.	.	3
1935	.	.	.	.	.	3	2	3	2	1	.	.	11
1936	.	.	.	.	.	.	3	.	1	1	.	.	5
1937	.	.	.	.	4	2	3	3	.	.	.	.	12
1938	.	.	.	.	.	2	5	3	2	2	.	.	14
Mean	.	.	.	0,1	0,9	0,6	1,7	1,2	0,8	0,4	.	.	5,7

ON DUST LEVELS IN THE AIR OF GDYNIA

Michał Żmijewski

ABSTRACT

In this work, the author inspected air dust levels in Gdynia for the period 1949-1954. He took under consideration both a continuous daily observation point for one part of the town, as well as four other observation points for determined constant periods of time; he has also cited the air dust levels in relationship to the time of day and season of the year. It was demonstrated that the amount of dust in the air is in relation to the location of the observation point with respect to the seashore and wind direction.

ON DUST LEVELS IN THE AIR OF GDYNIA

Michał Żmijewski

INTRODUCTION

The Earth's atmosphere, especially in the lower layers, includes a great amount of suspended matter, consisting of microscopic solid particles, as well as particles of soil, smoke from forest fires and peat bog fires, flower pollen, volcanic ash, cosmic dust, etc. In many industrial locations, air dust levels have a specific quality, containing dust from off the streets, soot, smokestack smoke, as well as factory emissions. In coastal locations, small crystals of salt are introduced into the air as a result of sea water evaporation of splashed or sprayed water occurring during wave action.

Dust is carried great distances by the wind at the Earth's surface, and rising currents and turbulent movement take dust into the upper levels of the atmosphere. In the lower levels, dust is composed of larger particles, and when the dust levels are high, these particles cause a significant reduction in visibility. Precipitation lowers air dust levels to a great extent.

The presence of dust in the atmosphere plays a large role in the occurrence of precipitation, as the dust particles form condensation nuclei. Hydroscopic molecules of those substances easily forming water solutions belong to these condensation nuclei, and in this way the germs of water drops are formed. These condensation nuclei may be salt crystals, as well as dust particles in the atmosphere. In this last case, the dust particles may be moistened. The size of a condensation nucleus may amount to about 10^{-6} cm.

Dust particles in the air also play a significant role in physical processes taking place in the atmosphere, because they absorb a great amount of radiant energy. The greatest light absorption takes place in many cities where the haziness of the atmosphere is at its greatest because of high dust levels in the air.

OBSERVATIONAL MATERIALS

Observational materials for the period 1949-1954 are used in the present work;

there are no breaks in observation, with the exception of those days when there was strong and long-term precipitation, that is, storms or thick fog. The whole extent of the observational material is composed of three kinds of air sampling.

The first type are dust-measurement observations carried out daily on Kaszubski Square at 1246 hours.

The second type are observations carried out on the 7th, 17th, and 27th of each month between the hours of 1030 and 1300* at five points in the city, namely: 1. Kaszubski Square, 2. Kamienna Hill, 3. on the seashore at the end of Zwycięstwa Avenue, 4. Constitution Square at the Główny Dworek (Main Residence), 5. at the Marine School on Czerwone Kosyniery Street (Fig. 1).

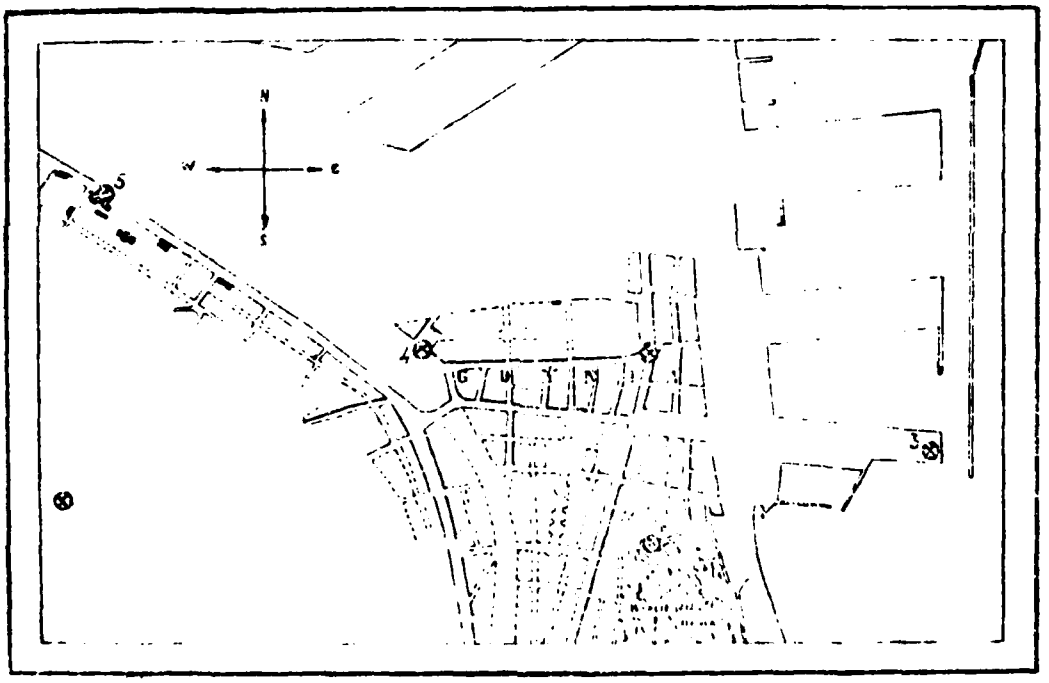

Fig. 1. Observation points for dust measurements in Gdynia.

The third kind are dust-measurement observations carried out on the 2nd, 12th, and 22nd days of each month in Kaszubski Square at 0646, 1246, and 2046 hours.

*In this work, official time is used.

MEASUREMENT METHODS

The dust measurement observations were begun in Gdynia at the end of November 1948, and from the end of that year they were carried out as sample observations. The observations proper were begun from the 1st of January 1949 and have been carried out with interruption up to the present time. The observations were undertaken with the help of a dust meter of the Owens system, sampling each time 500 cm^3 of air at an elevation of 1 m above ground level. The dust particles are deposited in the form of a narrow band or streak on a covered glass mounted on the dust meter. A micrometric mesh is used for counting the dust particles under /5
the microscope. A magnification of 100 x is used for counting the number of transverse strips in each unit length of the streak, and for counting the individual dust particles 1,000 x is used.

If we designate by S the number of strips in the mesh, and the amount of sampled air by C, then the number of dust particles W is:

$$W = \frac{NS}{C},$$

where $\frac{S}{C}$ is for the most part a constant magnitude, because the same number of cubic centimeters is used, as well as the same objective and eyepiece.

We must note that the numerical data derived in this way relating to the air dust levels in Gdynia are only relative values and not absolute ones. The sampling by means of the Owens dust meter gives a relatively small number of dust particles, and the visibility limits depend exclusively on the microscope magnification.

ANALYSIS OF MATERIALS

The observational material taken from the six-year observation period at Kaszubski Square is continuous and uniform. With every air sampling, the meteorological data, such as temperature, visibility, wind, etc. were recorded.

On the basis of the material collected, Table 1 was drawn up. The material collected in Table 1 shows that the maximum dust levels for the six-year period occur in July, whereas minimal levels occur in February. In November as well, December,

Table 1. Mean number of dust particles per cubic centimeter of air according to the observations at 1246 hours at Kaszubski Square in Gdynia for the period 1949-1954.

Years	Month I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
1949	114	73	124	168	210	152	206	193	[illegible]	201	198	194	170
1950	146	1.9	177	181	161	175	169	175	170	171	177	170	168
1951	167	169	162	191	184	195	186	179	177	188	174	177	178
1952	176	148	174	169	177	168	192	173	171	171	168	143	178
1953	175	153	178	191	178	194	191	182	171	176	181	170	177
1954	162	161	177	177	173	183	183	184	190	185	184	178	180
1949-1954	160	143	165	181	189	178	186	193	182	184	180	177	175

and January, the level of dust is lower than in the summer or autumn periods. During the winter season, the surface of the ground is often covered with a layer of snow, and this exerts an influence on the dust levels. There may be an exception /5
in this case in many cities where during the winter season, as a result of combustion in furnaces, large amounts of soot and smoke are introduced into the air.

For the purpose of showing the dust level course depending on the season of the year, three dust level intervals were used: lower than 150 dust particles per cubic centimeter; dust levels in the range 150-200 dust particles per cubic centimeter; and from 200-250 dust particles per cubic centimeter.

Table 2. Mean number of days according to the different dust level intervals according to season of the year in Kaszubski Square for the period 1949-1954

Season of the year	<150	150-200	200-250
Spring	14	64	16
Summer	7	67	17
Autumn	6	67	19
Winter	24	54	8
Year	50	255	60
%	13.7	69.9	16.4

From Table 2, it is apparent that the number of days with dust levels less than

150 particles per cubic centimeter prevailing, that is, 24, occurs during the winter, and the least number of such days occurs during the autumn. Within the dust level limits 150-200 particles per cubic centimeter, an equal number of days, that is, 67, occurs for the summer and autumn, and it is somewhat less for the spring, and even less, that is, 54, in the winter. In the last interval of 200-250 particles per cubic centimeters, the number of days of this kind of dust level amounts to 16 for the spring, 17 for the summer, and 19 for the autumn, whereas in the winter only eight such days occur, confirming once again that it is during the winter period that dust levels are markedly smaller. In terms of years, the course of dust levels is similar to the individual seasons of the year; the greatest number of days occurs in the interval from 150-200 particles (68.9%), and the least number in the group in which dust levels are lower than 150 particles (13.7%).

For the purposes of comparing the results of the observations undertaken at four points in the city with the data from Kaszubski Square, the kinds of data cited above were taken at three observation times for each month, that is, on the 7th, 17th, and 27th, and compiled in Table 3.

Table 3. Compilation of mean numbers of dust particles per cubic centimeter in the air for the annual course from observations on the 7th, 17th, and 27th of each month for the period 1949-1954

Locale	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Seashore	136	127	147	141	149	145	162	153	143	144	146	148	146
Kamienna Hill	149	128	157	149	159	156	170	158	162	164	163	159	156
Kaszubski Square	162	146	170	168	175	173	191	177	185	180	180	170	173
M. in Residence	178	153	177	183	184	183	199	189	195	188	187	187	183
Marine School	177	163	180	183	183	190	202	198	193	190	191	186	187

The mean values calculated for the six-year period show a marked maximum in July and a marked minimum in February. The six-year observational material shows that the smallest levels of dust occur at the seaside, amounting to on the average 146 particles per cubic centimeter. Depending on distances from the sea, the dust level increases and the greatest is at the Marine School, amounting to on the average 187 particles per cubic centimeter. This is due to the fact that the Marine School is located on a busy street with lively traffic, and in addition to this, several rail lines run nearby that have a great amount of rail traffic.

On the 2nd, 12th, and 22nd of each month, air samples were taken at Kaszubski Square at 0646, 1246, and 2046 hours. The results of these observations at the three sample times, I, II, and III, are compiled in Table 4.

Table 4. Daily course of air dust levels at Kaszubski Square for the 2nd, 12th, and 22nd of each month at 0646, 1246, and 2046 hours for the period 1949-1954

Month	Sample time			Mean monthl
	I	II	III	
January	140	164	142	149
February	126	141	129	132
March	137	159	141	146
April	156	183	157	165
May	158	198	166	177
June	143	173	156	159
July	160	190	167	172
August	157	180	165	167
September	156	189	163	166
October	154	184	160	166
November	162	184	165	170
December	157	176	164	166
Year	151	175	156	161

The observations undertaken across the course of the day show that the amount of dust in the air undergoes great changes. In the early morning hours, the level of dust is at its smallest, increasing, however, steadily and reaching a maximum at around 1300 hours, but then toward evening it declines. This phenomenon may be interpreted by the fact that during the morning, the winds are mostly weak, and these are the hours when dew is on the ground. During the day, the wind velocity increases, causing as well frequent updrafts which lead to an increase in the number of dust particles in the air. Towards evening, the wind dies down for the most part, and this has a marked effect on reducing dust levels.

Wind plays a very large role in dust levels in the air, because it carries dust for great distances. The extent of dust levels in the air depends to a great extent on wind direction. The results of measurements of this dependency undertaken at /5
Kaszubski Square are given in Table 5 and in Fig. 2.

Table 5. Mean annual number of dust particles per cubic centimeter in the air depending on wind direction on the basis of observations at 1246 hours at Kaszubski Square

Years	Direction																	Annual mean
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		
1949	80	96	66	110	117	107	99	112	116	128	109	117	163	151	164	92	165	121
1950	90	115	115	83	113	113	100	139	111	127	110	103	139	169	167	127	131	120
1951	85	111	77	84	112	106	112	106	104	91	103	129	138	164	165	158	171	127
1952	120	102	107	99	112	77	117	134	152	160	137	168	163	174	174	138	104	138
1953	140	61	122	49	40	80	142	124	135	132	139	155	167	197	141	106	125	114
1954	123	57	97	69	59	57	57	103	136	137	170	163	171	172	157	110	106	121
Year	105	91	111	83	92	99	113	126	130	129	142	145	166	172	172	122	130	125

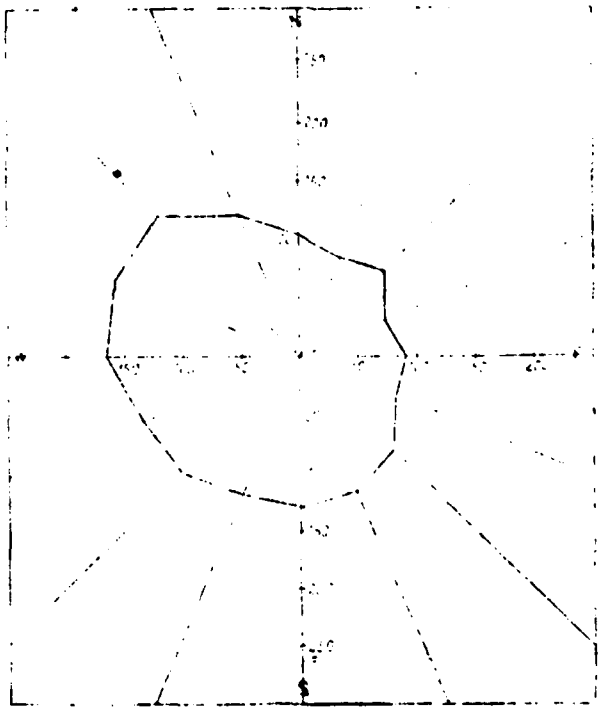

Fig. 2. Diagram of the dependency of dust levels in the air on wind direction at Kaszubski Square for the period 1949-1954

It is clear from Table 5 that the lowest levels of dust occur for wind directions out of the north to east-southeast, fluctuating within the limits 80-105 particles per cubic centimeter. Beginning with the southeasterly direction, dust levels

steadily increase and reach a maximum for the directions west-northwest and northwest, namely 172 particles per cubic centimeter, and after that they once again decrease. This dependency is also illustrated in Fig. 2.

CONCLUSIONS

The conclusions reached based on the observational material from the years 1949-1954 give a clear picture of air dust levels in Gdynia. From them, it appears that the air dust levels in Gdynia depend on the following:

(1) the place of observation, which is obvious in comparison of data taken at the seashore with the point at the greatest distance from the sea, the Marine School;

(2) the time of day, namely during the morning they are small, increasing towards noon and decreasing towards evening;

(3) the time of year, namely during the winter period they are small, increasing towards the summer;

(4) the wind direction -- the lowest dust levels are with winds out of the easterly direction; the greatest levels are with the prevailing westerly winds in Gdynia.

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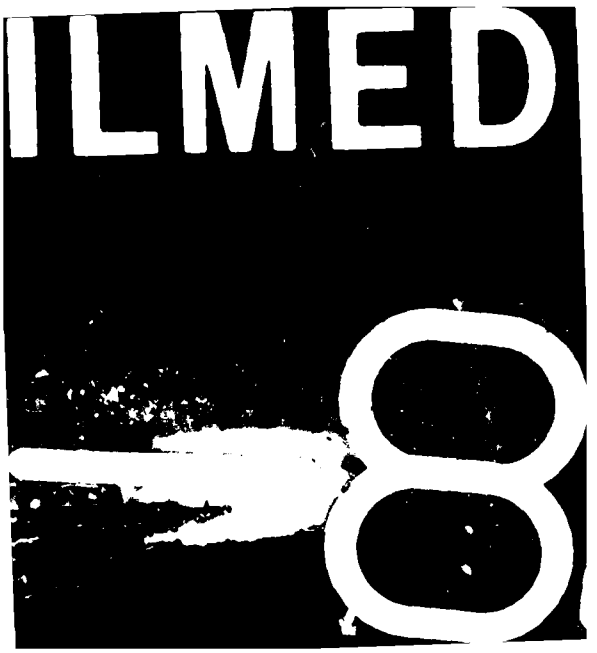
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